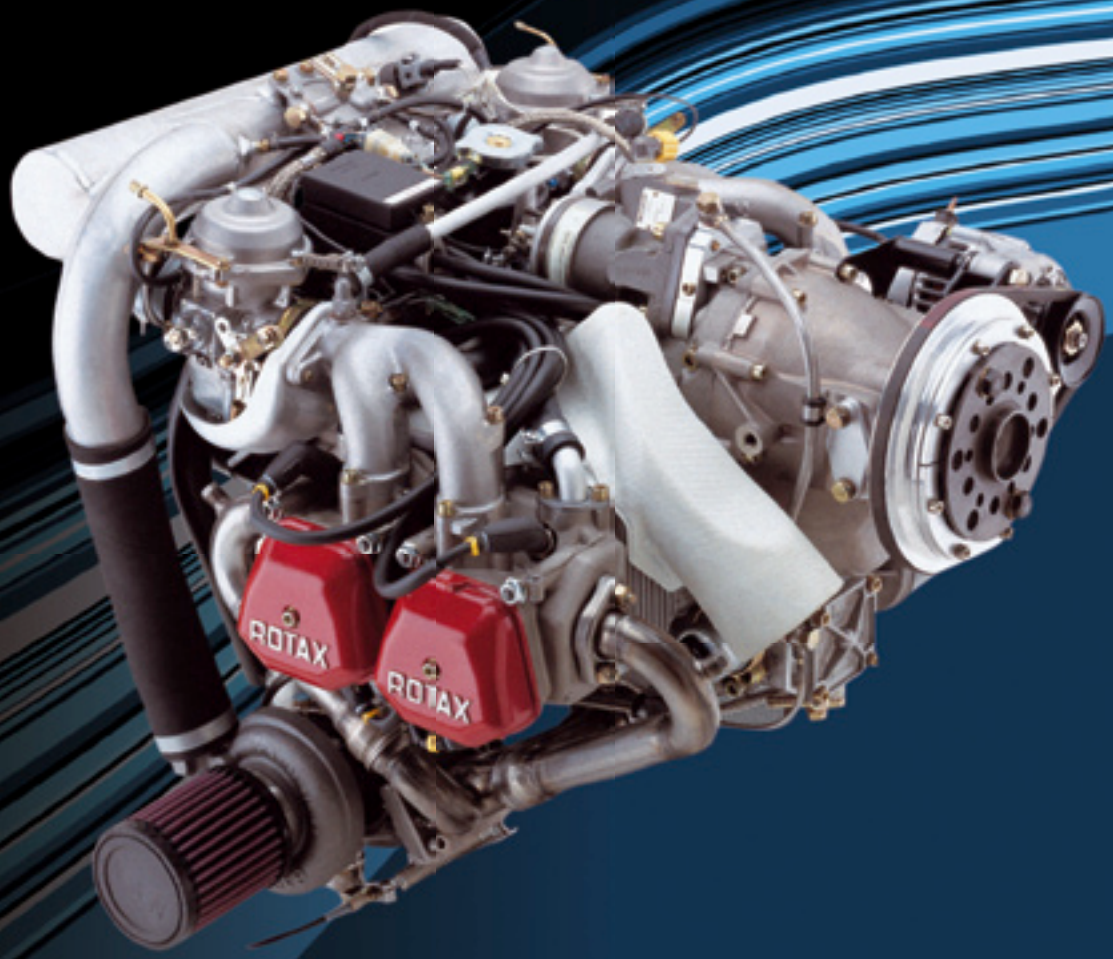
ROTAX®
AIRCRAFT ENGINES

INSTALLATION MANUAL

FOR ROTAX® ENGINE TYPE 914 SERIES



ROTAX® **914 UL 3** WITH OPTIONS

part no.: 897816

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⚠ WARNING

Before starting with engine installation, please read the Installation Manual completely as it contains important safety relevant information.

Approval of translation has been done to best knowledge and judgment in case the original text in the German language is authoritative.

d03186

1) Table of contents

1) Table of contents 3

2) Index 7

3) Preface 9

3.1) Remarks 9
3.2) Engine serial number 9

4) Safety 9

4.1) Repeating symbols 10
4.2) Safety information 10
4.3) Instruction 12
4.4) Technical documentation 13

5) List of the effective pages 15

6) Table of amendments 17

7) Description of design 19

7.1) Designation of type 19
7.2) Standard engine design 19
7.3) Engine components, engine views, definition of main axes 21

8) Technical data 23

8.1) Operating limits 23
8.2) Installation dimensions 24
8.3) Weights 24
8.4) Centre of gravity of engine and standard equipment 24
8.5) Moments of inertia 24

9) Preparations for engine installation 25

9.1) Transport 25
9.2) State of delivery 25
9.3) Engine preservation 25
9.4) Protective covering 26

10) Engine suspension and position 27

10.1) Definition of attachment points 28
10.2) Permissible fitting positions 29
10.3) General directives for engine suspension 31

11) Exhaust system 33

11.1) Operating limits 34

12) Cooling system 35

12.1) Description of the system 35
12.2) Operating limits 36
12.3) Coolant types 37
12.4) Check cooling system-Efficiency of the cooling system 38
12.4.1) Measurement of cylinder head temperature and coolant exit temperature 38
12.5) Determination of operating limits 39
12.6) Requirement on the cooling system 41
12.7) Size and position of connections 41
12.8) Coolant capacity 43
12.9) Feasible location of radiator 44

d03186

12.10) General directives for the cooling system 47
12.11) Cooling air ducting 48
12.11.1) General directives for ducting of the cooling air 49
13) Lubrication system 51
13.1) Description of the system 51
13.2) Limits of operation 52
13.3) Checking of the lubrication system 53
13.3.1) Measuring of the vacuum 53
13.3.2) Measuring of the pressure in the crankcase 54
13.4) Requirements on the oil- and venting lines 55
13.5) Connecting dimensions and location of connections 56
13.5.1) Oil circuit (engine) 56
13.5.2) Oil circuit (turbo charger) 57
13.5.3) Oil tank 58
13.6) Feasible position and location of the oil tank 59
13.7) Feasible position and location of the oil cooler 60
13.8) General notes on oil cooler 60
13.9) Filling capacity 60
13.10) Venting (purging or priming) of lubrication system 61
13.10.1) Venting (purging or priming) of turbocharger lubrication system 62
13.11) Inspection for correct venting (priming) of hydraulic valve tappets 62
13.12) Replacement of components 63
14) Fuel system 65
14.1) Description of system 65
14.2) Operating limits 66
14.3) Requirements of the fuel system 66
14.4) Connecting dimensions, location of joints and directives for installation 67
14.4.1) Electric fuel pump 67
14.4.2) Fuel pressure control 69
14.5) Notes on checking of fuel pressure 69
15) Carburetor 71
15.1) Requirements on the carburetor 71
15.2) Connections for Bowden-cable actuation and limit load. 72
15.3) Requirements on cable actuation 73
15.4) Requirements on the throttle lever 74
15.5) Location and determination of the throttle position for max. continuous power 75
16) Air intake system 77
16.1) Operating limits 77
16.2) Requirements on the air intake system 78
16.2.1) Requirements on the intake air ducting 78
16.2.2) Airfilter 80
16.2.3) Airbox 80
16.3) Notes to employment of the air filter 81
17) Pressure sensors 83
17.1) Static pressure sensor 84
18) Servo motor / Servo cable 85
18.1) Servo motor 85
18.2) Servo cable 86

d03186

19) Electric system 87

19.1) Requirements on circuit wiring 88
19.1.1) Electromagnetic compatibility (EMC) 88
19.2) Wiring diagram 89
19.3) Description of the Turbo Control Unit (TCU) 91
19.4) Technical data and connection of the electric components 91
19.4.1) Integrated generator 91
19.4.2) Rectifier-regulator 91
19.4.3) Electronic modules 93
19.4.4) Ignition switches (on-off switch) 93
19.4.5) Electric starter 94
19.4.6) Starter relay 95
19.4.7) Electric fuel pumps 96
19.4.8) Turbo Control Unit (TCU) 97
19.4.9) Isolating switch for servo motor 98
19.4.10) Boost lamp 99
19.4.11) Caution lamp 99
19.4.12) External alternator (optional extra) 100
19.4.13) Connection of the electric rev-counter (tachometer) 102
19.4.14) Battery 103
19.5) Internal consumer of electric power 103

20) Propeller drive 105

20.1) Technical data: 105

21) Vacuum pump 107

21.1) Technical data: 107

22) Hydraulic governor for constant speed propeller 109

22.1) Technical data: 109

23) Connections for instrumentation 111

23.1) Sensor for cylinder head temperature: 111
23.2) Sensor for oil temperature: 112
23.3) Oil pressure sensor 113
23.4) Mechanical rev-counter (tach drive): 114
23.5) Monitoring of the intake manifold pressure 115
23.6) Air temperature in the airbox (optional) 115

24) Preparations for trial run of engine 117

25) BRP-Rotax Authorized Distributors for Aircraft Engines 119

NOTES

2) Index

A
Acceleration 23
Air intake system 71
Air temperature in the airbox 109
Airbox 74
Airfilter 74
Attachment points 28
Auxiliary equipment 20

B
Bank angle 23
Battery 97

C
Carburetor 65
Caution light 93
Coarse filter 60
Connection of electric rev-counter 96
Connections (cooling system) 38
Connections (oil circuit) 52
Connections carburetor 66
Connections for instrumentation 105
Coolant capacity 40
Cooling system 35
Critical flight level 23
Current pages 15
Cylinder head temperature sensor 105

D
Definition of main axes 21
Denomination of cylinders 21
Description of design 19
Designation of type 19
Documentation 13
Drainage lines (airbox) 74
Drainage piping (drip tray) 65
Drip tray 65

E
Electric fuel pump 61, 90
Electric starter 88
Electromagnetic compatibility 82
Electronic modules 87
Elektric system 81
Engine components 21
Engine serial number 9
Engine speed 23
Engine suspension 27, 31
Engine views 21
Exhaust gas temperature 34
Exhaust system 33
Expansion tank 38
External alternator 94

F
Fine filter 60
Fitting positions 29
Fuel filter 60
Fuel pressure 60
Fuel pressure control 63
Fuel pressure-check 63
Fuel system 59

H
Hour-meter 108
Hydraulic governor for constant speed propeller 103

I
Ignition switches 87
Instruction 12
Instrumentation connection 105
Intake air ducting 72
Integrated generator 85
Intercooler 73
Internal consumer of electric power 97
Isolating switch for servo motor 92

L
Location of radiator 41
Lubrication system 47

M
Main axes 21
Manifold pressure 23
Manifold pressure connector 109
Mechanical rev-counter 108

O
Oil cooler 55
Oil lines 51
Oil pressure 48
Oil pressure sensor 107
Oil tank 53, 54
Oil temperature 48
On-off switch 87
Operating limits 23
Overflow bottle 42

P
Position of engine 27
Preface 9
Preservation (engine) 25
Pressure sensors 77
Propeller drive 99
Protective covering 26

R
Range of starting temperature 23
Rectifier-regulator 85
Remarks 9
Rev-counter drive 108

d03186

S

Safety 9
Safety information 10
Sensor for oil temperature 106
Servo motor 79
Standard engine design 19
Starter relay 89
State of delivery 25
Symbols 10

T

Take-off speed 23
Technical data 23
Technical documentation 13
Temperature in airbox 71
Throttle lever 68
Throttle position 69
Transport 25
Trial run 111
Turbo charger 72
Turbo Control Unit (TCU) 85, 91

V

Vacuum pump 101
Venting line of oil tank 51

W

Warning light 93
Water inlet bend 40
Wiring diagram (electric) 83

3) Preface

In this Manual the installation of all ROTAX 914 Series engines is described.

◆ NOTE: ROTAX 914 Series includes 914 F and 914 UL.

Before starting with the engine installation, read this Installation Manual carefully. The Manual will provide you with basic information on correct engine installation, a requirement for safe engine operation.

If any passages of the Manual are not completely understood or in case of questions, please, contact an authorized Distribution- or Service Center for ROTAX engines.

BRP-Rotax GmbH & Co. KG (hereinafter "BRP-Rotax") wish you much pleasure and satisfaction flying your aircraft powered by this ROTAX engine.

3.1) Remarks

This Installation Manual is to acquaint the owner/user of this aircraft engine with basic installation instructions and safety information.

For more detailed information on operation, maintenance, safety- or flight, consult the documentation provided by the aircraft manufacturer and dealer.

For further information on maintenance and spare part service contact the nearest BRP-Rotax distributor (see chapter Distributors).

3.2) Engine serial number

On all enquiries or spare parts orders, always indicate the engine serial number, as the manufacturer makes modifications to the engine for further development.

The engine serial number is on the top of the crankcase, magneto side.

4) Safety

Although the mere reading of these instructions will not eliminate a hazard, the understanding and application of the information herein will promote the proper installation and use of the engine.

The information and components-/system descriptions contained in this Installation Manual are correct at the time of publication. BRP-Rotax, however, maintains a policy of continuous improvement of its products without imposing upon itself any obligation to install them on its products previously manufactured.

BRP-Rotax reserves the right at any time to discontinue or change specifications, designs, features, models or equipment without incurring obligation.

The illustrations in this Installation Manual show the typical construction. They may not represent in full detail or the exact shape of the parts which have the same or similar function.

Specifications are given in the SI metric system with the USA equivalent in parenthesis. Where precise accuracy is not required, some conversions are rounded off for easier use.

03187

4.1) Repeating symbols

This Manual uses the following symbols to emphasize particular information. These indications are important and must be respected.

▲ WARNING: Identifies an instruction which, if not followed, may cause serious injury including the possibility of death.

■ CAUTION: Denotes an instruction which, if not followed, may severely damage the engine or other component.

◆ NOTE: Indicates supplementary information which may be needed to fully complete or understand an instruction.

4.2) Safety information

▲ WARNING: Only certified technicians (authorized by the local airworthiness authorities) and trained on this product are qualified to work on these engines.

▲ WARNING: Never fly the aircraft equipped with this engine at locations, air-speeds, altitudes, of other circumstances from which a successful no-power landing cannot be made, after sudden engine stoppage. Unless correctly equipped to provide enough electrical power for night VFR (according latest requirement as ASTM), the ROTAX® 912 UL/ULS/ULSFR is restricted to DAY VFR only.

- This engine is not suitable for acrobatics (inverted flight, etc.).
- This engine shall not be used on rotor wing aircraft (helicopters, gyrocopters, etc.) or any similar aircraft.
- It should be clearly understood that the choice, selection and use *of this* particular engine on any aircraft is at the sole discretion and responsibility of the aircraft manufacturer, assembler and owner/user.
- Due to the varying designs, equipment and types of aircraft, BRP-Rotax makes no warranty or representation on the suitability of its engine's use on any particular aircraft. Further, BRP-Rotax makes no warranty or representation of this engine's suitability with any other part, component or system which may be selected by the aircraft manufacturer, assembler or user for aircraft application.
- Unless in a run up area, never run the engine with the propeller turning while on the ground. Do not operate engine if bystanders are close.
- To prevent unauthorized use, never leave the aircraft unattended with the engine running.
- To eliminate possible injury or damage, ensure that any loose equipment or tools are properly secured before starting the engine.

- When in storage protect the engine and fuel system from contamination and exposure.
- Never operate the engine and gearbox without sufficient quantities of lubricating oil.
- Never exceed maximum rated r.p.m. and allow the engine to cool at idle for several minutes before turning off the engine.
- The engine should only be installed and placed into operation by persons familiar with the use of the engine and informed with regard to possible hazards.
- Never run the engine without a propeller as this will inevitably cause engine damage and present a hazard of explosion.
- Propeller and its attachment with a moment of inertia in excess of the specified value must not be used and releases engine manufacturer from any liability.
- Improper engine installation and use of unsuitable piping for fuel,- cooling,- and lubrication system releases engine manufacturer from any liability.
- Unauthorized modifications of engine or aircraft will automatically exclude any liability of the manufacturer for sequential damage.
- In addition to observing the instructions in our Manual, general safety and accident preventative measures, legal regulations and regulations of any aeronautical authority must be observed.
- Where differences exist between this Manual and regulations provided by any authority, the more stringent regulation should be applied.
- This engine may be equipped with an other than the ORIGINAL-ROTAX air pump. The safety warning accompanying the air pump must be given to the owner/ operator of the aircraft into which the air pump is installed.

03187

4.3) Instruction

Engines require instructions regarding their application, use, operation, maintenance and repair.

- Technical documentation and directions are useful and necessary complementary elements for personal instruction, but can by no means substitute theoretical and practical instructions.
- These instructions should cover explanation of the technical context, advice for operation, maintenance, use and operational safety of the engine.
- All technical directives relevant for safety are especially emphasized. Pass on safety instructions to other users, without fail.
- This engine must only be operated with accessories supplied, recommended and released by BRP-Rotax. Modifications are only allowed after consent by the engine manufacturer.

■ CAUTION: Spare parts must meet with the requirements defined by the engine manufacturer. This is only warranted by use of GENUINE ROTAX spare parts and/or accessories (see illustrated parts catalog).

They are available only at the authorized BRP-Rotax Distribution- and Service Centers.

The use of anything other than genuine ROTAX spare parts and/or accessories will render any warranty relating to this engine null and void (see Warranty Conditions).

▲ WARNING: Engine and gear box are delivered in "dry" conditions (without oil). Before putting engine in operation it must be filled with oil. Use only oil as specified (consult Operator‘s Manual).

▲ WARNING: Exclusively use tools and supplementary materials as listed in the Illustrated Parts Catalog.

▲ WARNING: This Manual for engine installation is only part of the Technical Documentation and will be supplemented by the respective Operator‘s Manual, Maintenance Manual and Spare Parts List.

Pay attention to references to other documentation, found in various parts of this Manual.

O3187

4.4) Technical documentation

The information given in the

- Installation Manual
- Operator‘s Manual
- Maintenance Manual (Line Maintenance)
  (Heavy Maintenance)
- Overhaul Manual
- Illustrated Parts Catalog (IPC)
- Alert Service Bulletin
- Service Bulletins
- Service Informations
- Service Letter
- User Manual

are based on data and experience that are considered applicable for professionals under normal conditions.

The rapid technical progress and variations of installation might render present laws and regulations inapplicable or inadequate.

The illustrations in this Manual are mere sketches and show a typical arrangement. They may not represent the actual part in all its details but depict parts of the same or similar function. Therefore deduction of dimensions or other details from illustrations is not permitted.

◆ NOTE: The illustrations in this Manual are managed in a graphic data base and are identified by a consecutive, non-corresponding number.

This No. (e.g. 00277) does not have any meaning concerning the content!

All necessary documentation is available from the BRP-Rotax Distribution and Service Center.

03187

NOTES

5) List of the effective pages

00567

chapter	page	date
0	1	2006 07 01
	2	2006 07 01
1	3	2006 07 01
	4	2006 07 01
	5	2006 07 01
	6	2006 07 01
2	7	2006 07 01
	8	2006 07 01
3,4	9	2006 07 01
4	10	2006 07 01
	11	2006 07 01
	12	2006 07 01
	13	2006 07 01
	14	2006 07 01
5	15	2006 07 01
	16	2006 07 01
6	17	2006 07 01
	18	2006 07 01
7	19	2006 07 01
	20	2006 07 01
	21	2006 07 01
	22	2006 07 01
8	23	2006 07 01
	24	2006 07 01
9	25	2006 07 01
	26	2006 07 01
10	27	2006 07 01
	28	2006 07 01
	29	2006 07 01
	30	2006 07 01
	31	2006 07 01
	32	2006 07 01
11	33	2006 07 01
	34	2006 07 01
12	35	2006 07 01
	36	2006 07 01
	37	2006 07 01
	38	2006 07 01
	39	2006 07 01
	40	2006 07 01
	41	2006 07 01
	42	2006 07 01
	43	2006 07 01
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	46	2006 07 01
	47	2006 07 01
	48	2006 07 01
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	114	2006 07 01
	115	2006 07 01
	116	2006 07 01
24	117	2006 07 01
	118	2006 07 01
25	119	2006 07 01
	120	2006 07 01

03187

NOTES

6) Table of amendments

Approval*

The technical content is approved under the authority of DOA Nr. EASA.21J.048.

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no.	chapter	page	date of change	remark for approval	date of approval from authorities	date of inclusion	signature
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03187

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7) Description of design

7.1) Designation of type

Basic type

e.g. ROTAX 914 version 2:

version 2: with prop flange for fix pitch propeller

version 3: with prop flange with drive of hydraulic governor for constant speed propeller

version 4: with prop flange for fix pitch propeller, but prepared for retro-fit of hydraulic governor for constant speed prop

Optional extras to the above stated basic type:

	external alternator	vacuum pump	drive for rev-counter/ hour meter	governor
for version 2	yes	yes	yes	no
for version 3	yes	no	yes	yes
for version 4	yes	yes	yes	no

O 8116

◆ NOTE: Conversion of the version 2 / 4 to version 3 may be accomplished by BRP-Rotax Authorized Distributors or their Service Center.

7.2) Standard engine design

- 4 stroke, 4 cyl. horizontally opposed, spark ignition engine with turbo charger, single central camshaft hydraulic tappets - push rods - OHV
- liquid cooled cylinder heads
- ram air cooled cylinders
- dry sump, forced lubrication
- dual ignition of breakerless, capacitor discharge design
- 2 constant depression carburetors and airbox
- 2 electric fuel pumps (12V DC)
- prop drive via integrated gear box with torsional shock absorber and overload clutch (optional on configuration UL2/UL4)
- stainless steel exhaust system
- engine suspension frame
- expansion tank (coolant)
- electric starter or starter with extended power output
- integrated AC generator with external rectifier regulator

O 3188

- oil tank
- external start relay
- hydraulic governor for constant speed prop (on version 3 only)

Auxiliary equipment (optional)

■ CAUTION: Any equipment not included as part of the standard engine version and thus not a fix component of the engine is not in the volume of supply.

Components especially developed and tested for this engine are readily available at BRP-Rotax.

Following auxiliary equipment has been tested on ROTAX engine type 914 for safety and durability to the standards of aviation.

The furnishing of proof in accordance to the latest FAR or EASA has to be conducted by the aircraft manufacturer.

- external alternator
- vacuum pump (feasible on version 2 and version 4 only)
- drive for rev-counter / hour-meter
- oil cooler with connections
- coolant radiator
- coolant overflow bottle

Following equipment has <u>not</u> been tested for safety and durability to the standards of aviation.

▲ WARNING: The user assumes all risks possibly arising by utilizing auxiliary equipment.

The furnishing of proof in accordance to the latest FAR or EASA has to be conducted by the aircraft manufacturer.

- intake filter
- Flydat
- mechanical rev counter
- electric rev counter
- hour-meter
- shock mount

O3188

7.3) Engine components, engine views, definition of main axes

See fig. 2/3/4/5/6.

PTO power take off side

MS magneto side

A points of attachment for engine transport

⊕ centre of gravity

P zero reference point for all dimensions

◆ NOTE: Allow ±1 mm on all stated dimensions as manufacturing tolerance

x,y,z axes for system of coordinates

Cyl.1	Cylinder 1	Cyl.3	Cylinder 3
Cyl.2	Cylinder 2	Cyl.4	Cylinder 4

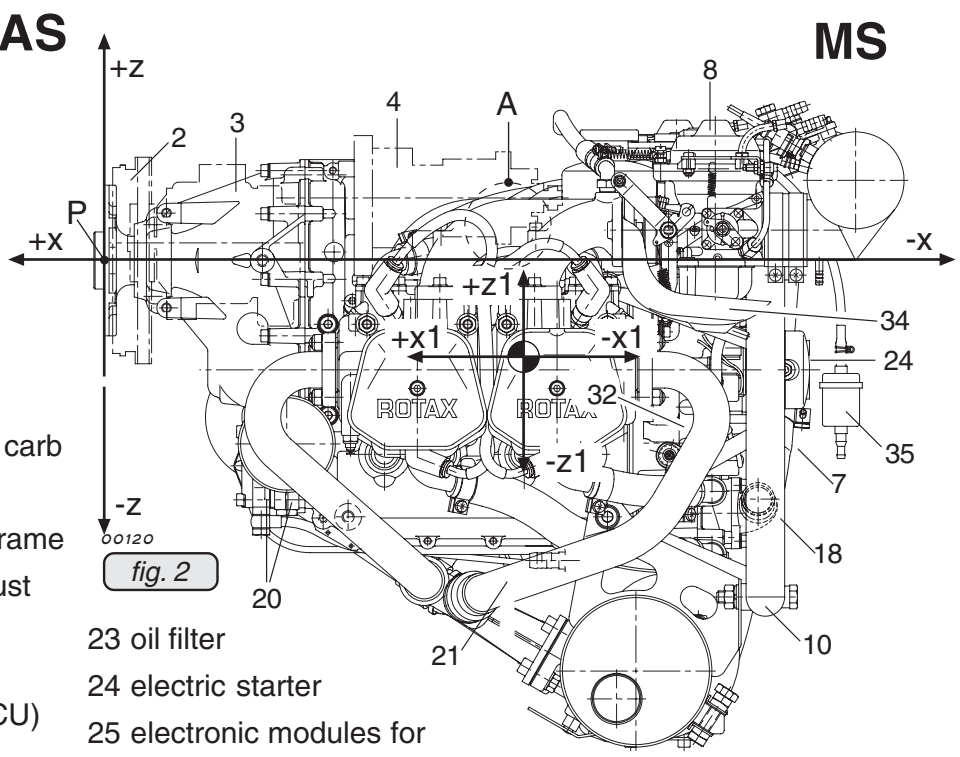


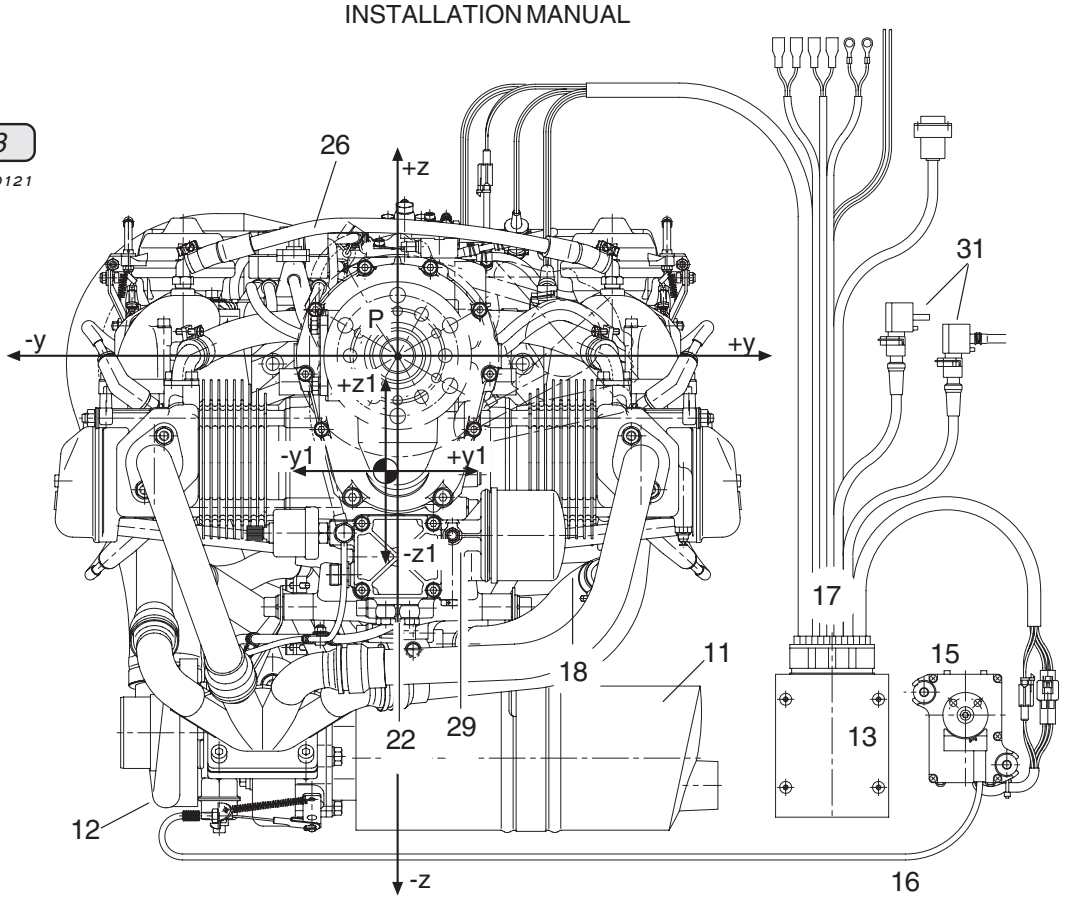
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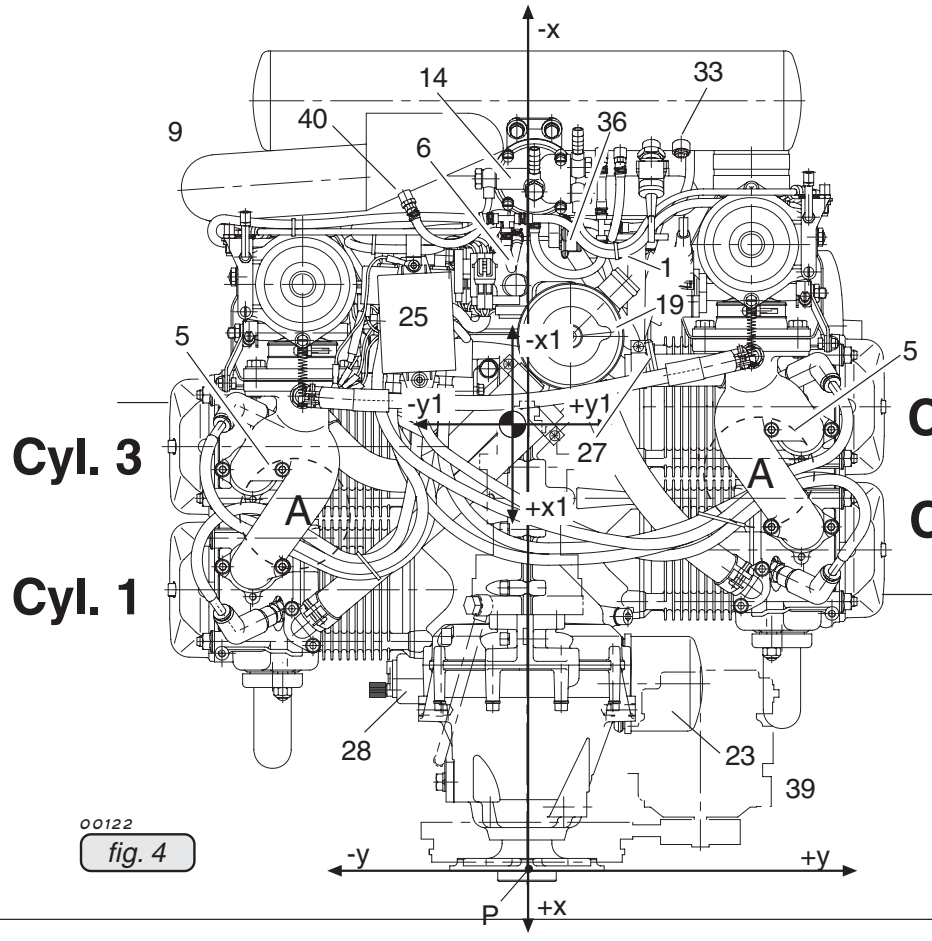
1 engine number
2 propeller flange
3 propeller gear
4 vacuum pump or hydraulic governor for constant speed propeller
5 intake manifold
6 ignition housing
7 ignition cover
8 constant depression carb
9 airbox
10 engine suspension frame
11 stainless steel exhaust system
12 turbocharger
13 turbo control unit (TCU)
14 fuel pressure control
15 servo motor
16 servo cable
17 cable assembly
18 coolant pump
19 expansion tank
20 2 separate oil pumps
21 connection for oil return line (engine)
22 connection for oil return line (turbo)
23 oil filter
24 electric starter
25 electronic modules for ignition
26 compensation tube
27 connection for manifold pressure
28 sensor for oil pressure
29 sensor for oil temperature
30 sensor for cylinder head temperature
31 2x pressure sensor
32 connection for mechanical rev-counter
33 connection for additional temperature sensor (airbox)
34 drip tray
35 water trap
36 three way solenoid valve
37 2x electric fuel pump
38 oil tank
39 external alternator
40 enrichment jet

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fig. 3

00121





00122

fig. 4

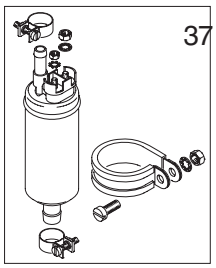
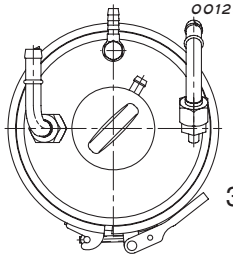


fig. 5

00123

fig. 6

00124



03188

8) Technical data

To maintain clarity, only data relevant for engine installation and operation will be stated in the Manual.

◆ NOTE: Connecting dimensions, filling capacities, drive and reduction ratios, electric output etc. can be found in the respective chapter of engine installation or other relevant engine documentation. (see chap. 4.4)

8.1) Operating limits

1. **Engine speed .....** see Operators Manual 914 Series, chap. 10.1.
2. **Manifold pressure: .....** see Operators Manual 914 Series, chap. 10.1.
3. **Acceleration: .....** see Operators Manual 914 Series, chap. 10.1.
4. **Critical flight level .....** see Operators Manual 914 Series, chap. 10.1.
5. **Oil pressure: .....** see Operators Manual 914 Series, chap. 10.1.
6. **Oil temperature: .....** see Operators Manual 914 Series, chap. 10.1.
7. **Cyl. head temperature: .....** see Operators Manual 914 Series, chap. 10.1.
8. **Exhaust gas temperature:** ..... see chapter 11.1
9. **Airbox temperature:** ..... see chapter 16.1
10. **Range of starting temperature:**
    max. ..... 50 °C (122 °F)
    min. ..... -25 °C (-13 °F)
11. **Fuel pressure: .....** see Operators Manual 914 Series, chap. 10.1.
12. **Banking of plane deviation from the effective vertical:**
    See Operators Manual 914 Series, chap. 10.1.
    The engine design is for a conventional, non-aerobatic, fixed wing tractor or pusher type configuration with the oil return port in the optimum position (see chap. 13.5). With this consideration the engine is properly lubricated in all flight profiles.

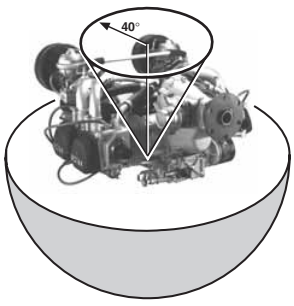


fig. 7

04849

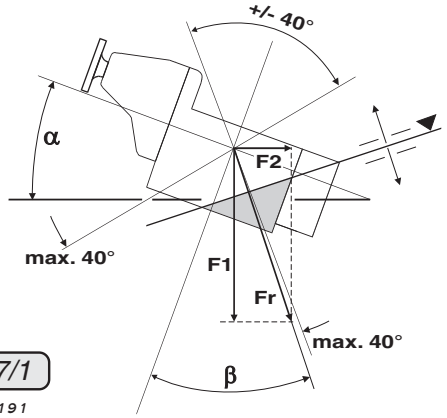


fig. 7/1

07191

α	pitch or roll
β	current bank angle
F1	gravity
F2	acceleration
Fr	result of F1 and F2

The resulting bank angle β (depending on acceleration/deceleration) may never exceed the max. bank angle.

◆ NOTE: Pitch or role angle α is not equal with β, except stabilized condition (without acceleration).

03188

8.2) Installation dimensions (all dimensions in mm)

See fig. 2/3/4.

◆ NOTE: Dimensions to point of reference (P). See fig. 2/3/4.

	Standard engine version		
	pos. (+)	neg. (-)	total Σ
max. dimension in x-axis (mm)	8,5	-656,6	665,1
max. dimension in y-axis (mm)	288	-288	576,0
max. dimension in z-axis (mm)	220	-311	531,0

04858

8.3) Weights

Weight of engine defined to the following conditions:

- **Engine dry** from serial production with int. alternator, with overload clutch, without fuel pumps (see chapter Description of design)

Engine weight .... Version 2 and 4: ..... 71,7 kg (158 lb)

Version 3: ..... 74,4 kg (164 lb)

Weight of ..... external generator assy. ..... 3,0 kg (6.6 lb)

overload clutch ..... 1,7 kg (3.7 lb)

vacuum pump assy. ..... 0,8 kg (1.76 lb)

hydraulic governor assy. ..... 2,7 kg (6 lb)

HD-starter ..... additional + 0,43 kg (1 lb)

8.4) Centre of gravity of engine and standard equipment

See fig. 2/3/4.

	engine from serial production 3	external alternator	hydraulic governor	vacuum pump
centre of gravity in x-axis (mm)	-327	-100	-276	-255
centre of gravity in y-axis (mm)	-9	139	0	0
centre of gravity in z-axis (mm)	-102	6	56	56

04859

◆ NOTE: Dimensions to point of reference (P). See fig. 2/3/4.

8.5) Moments of inertia

See fig. 2/3/4.

	engine version 2 / 4	engine version 3
moment of inertia around axis x1 - x1 (kg cm²)	20 470	21 210
moment of inertia around axis y1 - y1 (kg cm²)	24 560	25 450
moment of inertia around axis z1 - z1 (kg cm²)	26 520	27 480

04860

03188

9) Preparations for engine installation

■ CAUTION: The stated directives are measures to pay CAUTION to at engine installation to prevent any accidents and engine damage.

9.1) Transport

The engine to be lifted by two hooks or straps around the middle of the intake manifolds.

See chapter engine views, numbering of cylinders and definition of main axes.

9.2) State of delivery

The engine is attached with to steel angles anchored on a timber plate.

■ CAUTION: The attachment screws are only for transport and must not be used in the aircraft.

9.3) Engine preservation

The engine is preserved at BRP-Rotax thus warranting proper protection against corrosion for at least **12** month after date of delivery from BRP-Rotax.

This warranty is subject to the following conditions:

- the engine has to be stored in the packing as supplied by BRP-Rotax.
- the covers on various openings must not be removed (see chapter of protective covering)
- engine has to be stored in a suitable place (at min. - 40 °C (- 40 °F) and max. + 80 °C (+ 176 °F)).

If the engine is stored for a period longer than 12 month perform every 3 months the tasks given in the current valid Maintenance Manual, chapter 11.11.1 "Preservation of a new engine".

O 3188

9.4) Protective covering

All openings are protected against ingress of contamination and dampness. It is recommended not to remove these plugs until installation of the specific feed line.

◆ NOTE: If the engine will be sent to the manufacturer or distributor reuse transport equipment and replug openings.

List of protective covering:

- exhaust socket: ..... 1x cone plug
- air intake socket on turbo: ..... 1x cover
- connection for manifold pressure: ..... 1x cap
- fuel pressure control (in-and outlet): ..... 1x each cap
- oil supply and oil discharge: ..... 1x each cap
- oil return (turbo): ..... 1x cap
- supply and discharge of coolant: ..... 1x each cone plug
- propshaft on version 3: ..... 1x disk plug
- airbox: ..... 2x cap

▲ WARNING: Protective covering to be utilized for transport and at engine installation only. Before engine operation remove these protections.

O3188

10) Engine suspension and position

■ CAUTION: At installation of engine be aware of engine weight and assure careful handling.

The engine suspension is determined essentially by the aircraft design. Eight attachment points are provided on the engine (4 on engine and 4 on engine frame).

The engine will be supplied with a well tried and certified suspension frame for attachment on the fire proof bulk head. The exhaust system and the turbo charger are supported on this frame too. The installation into the aircraft is as generally practised by captive rubber mounts which ensure also to balance out vibrations and sound from engine to aircraft frame.

▲ WARNING: If the engine suspension frame supplied by BRP-Rotax is not used or if modified, certification to the latest requirements such as FAR or EASA has to be conducted by the aircraft manufacturer.

Furthermore a suitable suspension for turbo charger and exhaust system has to be developed. **Since these components weigh approx. 6 kg (13 lbs), this suspension has to be carefully designed and tested.** Certification to the latest requirements such as FAR or EASA has to be conducted by the aircraft manufacturer.

▲ WARNING: The hex. hd. screws M10x60 (1) on the attachment points R2 and L2 are only used for transport securing but must never be utilized for engine suspension. See fig. 9.

Therefore it is recommended to use the ROTAX engine suspension frame and the 4 stated attachment points R2, L2, R3 and L3 .

▲ WARNING: At least 4 of the eight anchorage points must be used in a side symmetrical pattern of the left (L) and right (R) side.

d03189

10.1) Definition of attachment points

See fig. 9/10.

fig. 9

02452

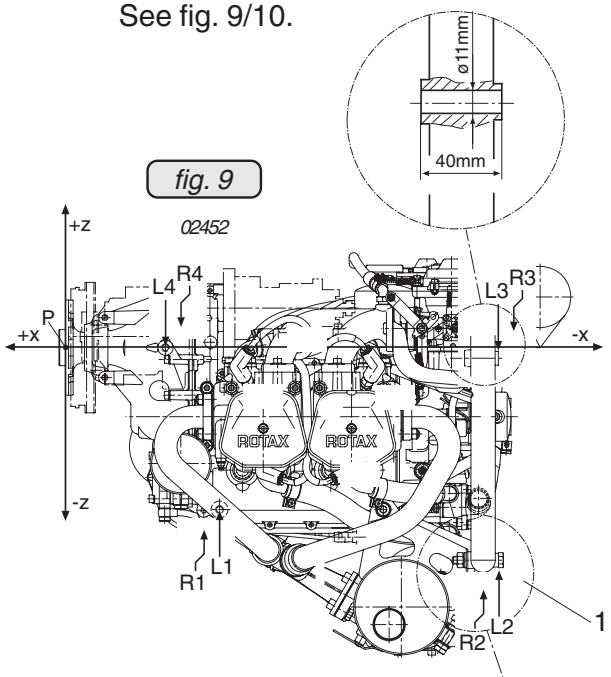
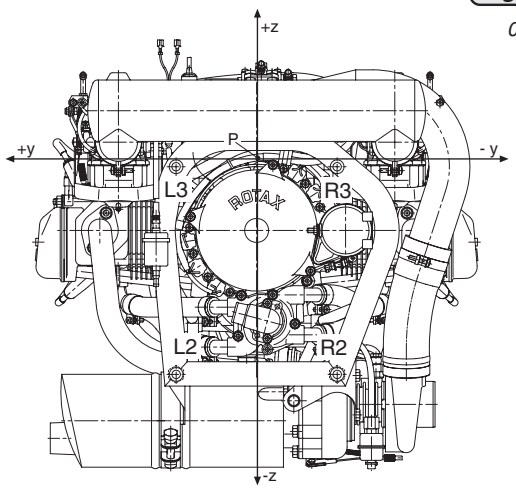


fig. 10

03201



07137

	attachment point			
	L1	R1	L4	R4
thread size	M10			
max. usable thread length	25 mm		19 mm [1]	
max. usable thread length	25 mm		16 mm [2]	

04829

attachment point	Axes		
	x axis (mm)	y axis (mm)	z axis (mm)
L1	-200,8	-71,0	-211,0
R1	-200,8	71,0	-211,0
L2	-564,0	105,0	-277,0
R2	-564,0	-105,0	-277,0
L3	-564,0	105,0	-7,0
R3	-564,0	-105,0	-7,0
L4	-128,3	87,0	0,0
R4	-128,3	-87,0	0,0

[1] up to gearbox s/n 28986

[2] starting from gearbox s/n 28987

▲ WARNING: The engine suspension to be designed by the aircraft or fuselage builder such that it will carry safely the maximum occurring operational loads without exceeding the max. allowable-forces and moments on the engine attachment points.

04861

04862

	attachment point			
	L2	R2	L3	R3
max. allowable forces (limit load) in (N)				
in x axis	5 000			
in y axis	2 000			
in z axis	3 000			
max. allowable bending moment (limit load) in (Nm) in x, y and z axis	100			

▲ WARNING: Tighten all engine suspension screws as specified by the aircraft manufacturer.

d03189

10.2) Permissible fitting positions

See fig. 11/12/13.

To simplify the matter, reference is made only to the 2 engine attachment points R1, L1 and the 2 turbo charger attachment points R(T)2 and L(T)2.

Location of the 2 turbo charger attachment points R(T)2 und L(T)2.

◆ NOTE: All dimensions to point of reference (P) and the system of coordinates remain unchanged.

	Axes		
attachment point	x axis mm	y axis mm	z axis mm
L(T)2	-414,3	71,0	-211,0
R(T)2	-414,3	-71,0	-211,0

04863

The following details of engine position are with reference to aircraft on ground, ready for take off.

- engine suitable for propeller in tractor or pusher arrangement,
- propeller shaft above cylinders. See fig. 2.

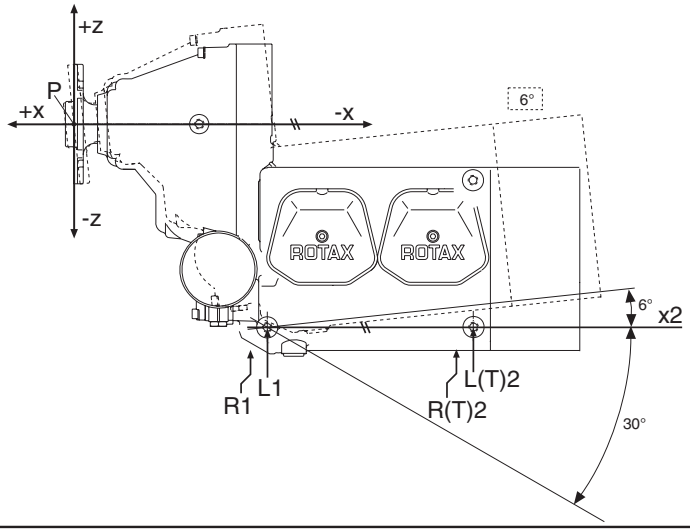
▲ WARNING: For upside down installation of the engine, the lubrication system, fuel system and the cooling system are unsuitable!

<u>Longitudinal axis:</u>

- The centre of the attachment points L1 and L(T)2 must be on axis x2 parallel to the x axis.

  Allowable pitch deviation of parallelism of axes:
  max. 6° counter-clockwise, **on ground**
  max. 10° counter-clockwise, **in operation**
  max. 30° clockwise (see fig. 11)

▲ WARNING: On installations with fuel tank located above carburetor level combined with badly closing carb float valve, fuel could pass into cylinders at more than 6° decline of propeller shaft axis after longer periods of downtime. See FAR, § 33.17.



d03189

To prevent a possible hydraulic shock at engine start, ensure proper closing of float valves. If in doubt, park the aircraft with inclining propeller shaft axis.

fig. 11

02453

Propeller axis:

- The centres of attachment points L1 und R1 must be on an axis y2 parallel to y-axis.

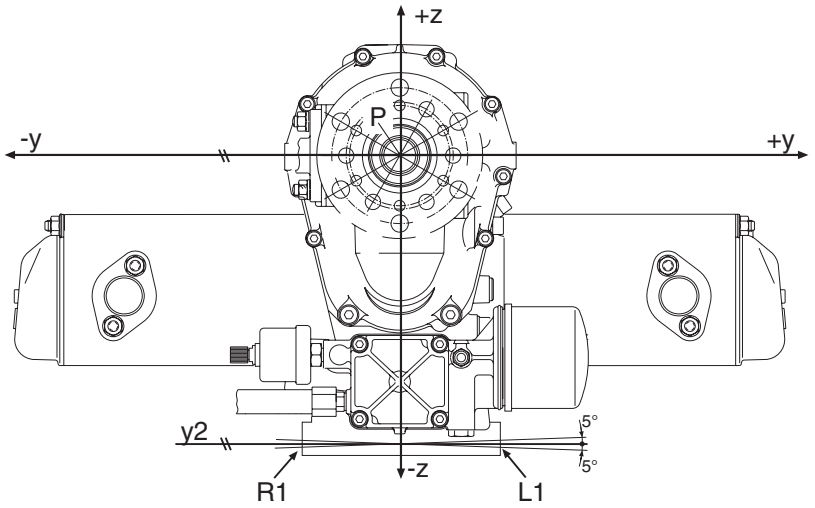


fig. 12

02454

Tolerated roll deviation of parallelism: ..... ± 5°. (see fig. 12)

Vertical axis:

- y-axis must be square to the longitudinal axis of the aircraft.

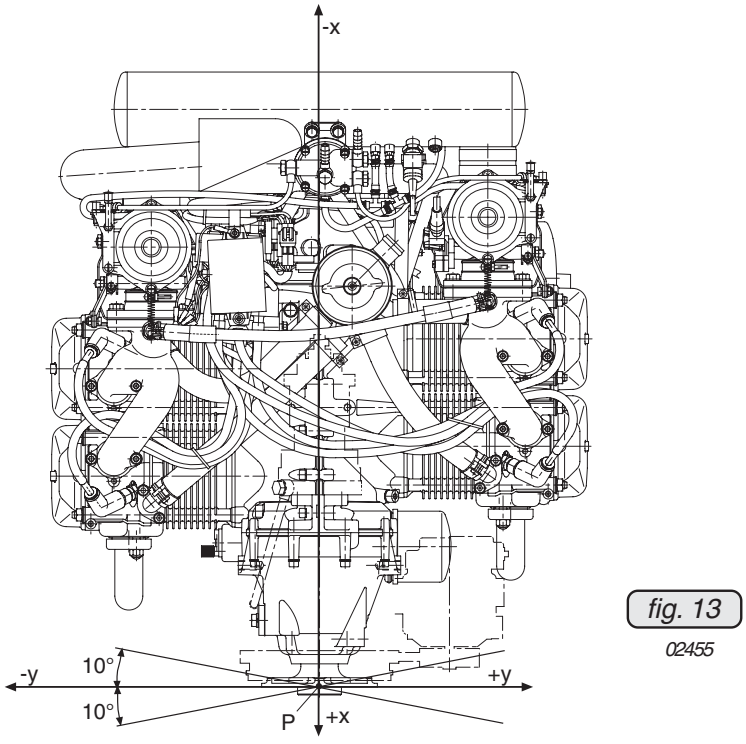


fig. 13

02455

Tolerated roll deviation of Yaw tolerance: ± 10° (see fig. 13)

d03189

10.3) General directives for engine suspension

Rubber mounts to be used between engine and aircraft frame to neutralize vibrations.

Damping elements as generally used in the aircraft industry (e.g. LORD) are suitable. See fig. 14.

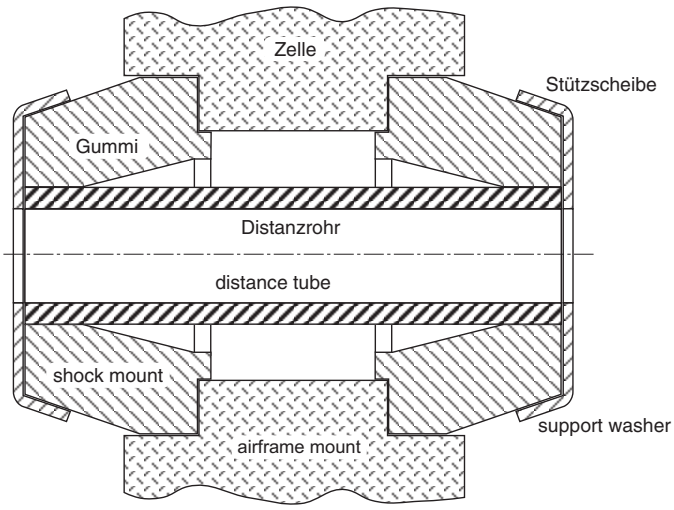


fig. 14

07600

◆ NOTE:
The fig. shows rubber mount Lord J 3608-1 resp. J 3608-2.

▲ WARNING:
All elements to balance out vibrations have to be of captive design.

◆ NOTE: With suspension on the 4 top lugs L3, R3, L4 and R4 only, the tilting moment due to the pull of the propeller will be avoided while, if attached on the bottom lugs only, the moment of tilting has to be taken care of accordingly.

▲ WARNING: The rubber mounts to neutralize vibrations and all the engine suspension components not in the supply volume must be ground run tested to the specified loads and for vibration behaviour. Certification to the latest requirements such as FAR or EASA has to be conducted by the aircraft manufacturer.

■ CAUTION: The engine suspension has to be designed to prevent any excessive engine movement and to minimize noise emission and vibration on air frame side.

See also SL-912-010 "Identifying abnormal vibrations on aircrafts", latest issue.

d03189

NOTES

d03189

11) Exhaust system

See fig. 15.

The complete exhaust system is in the volume of supply and is certified together with the engine.

▲ WARNING: If the ROTAX exhaust system is not employed or if modified, certification to the latest requirements such as FAR or EASA has to be conducted by the aircraft manufacturer.

Modifications are permissible only if agreed with by BRP-Rotax.

◆ NOTE: As an exception, the exhaust tail pipe can be modified to the following requirements:

- Mean bending radius of an tail pipe: min. 40 mm (1.57 in.)
- Exhaust bend, inside diameter: min. 38 mm (1.50 in.)
- Medium tube length: max. 250 mm (10 in.)
- The insertion depth of the tail pipe into the muffler must be ensured (see fig.15/1).

■ CAUTION: At a medium tube length of 250 mm (10 in.) and more, the tail pipe must have additional support.

Material of the exhaust system: X 15CrNiSi 20 (DIN 1.4828) (AISI 309)

Location of the exhaust tail pipe (P1)

See fig. 15.

07618

	Axes		
Tube end P1	x axis mm	y axis mm	z axis mm
	-438	+211	-338

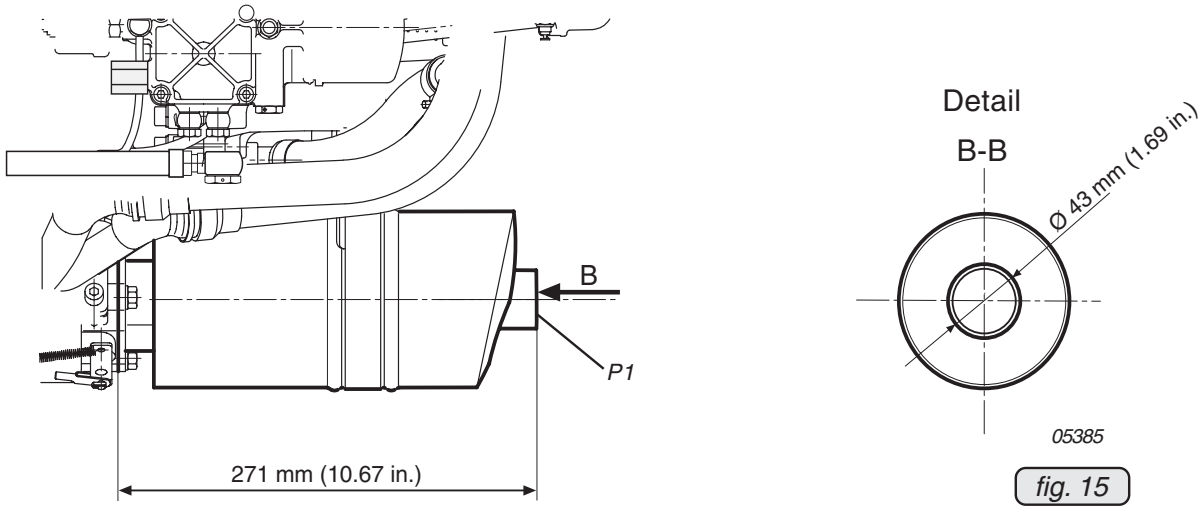
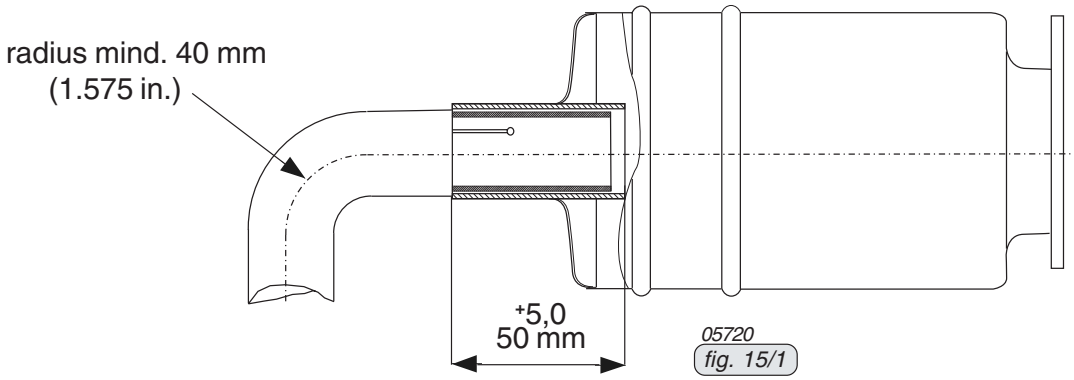


fig. 15

■ CAUTION: Always fit heat shields near carburetors or as required.

Because of the high temperatures occurring, provide suitable protection against unintentional contact.

d03189



05720
fig. 15/1

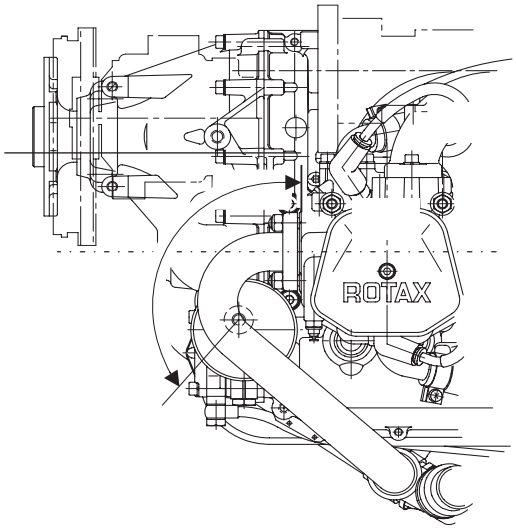
11.1) Operating limits

Exhaust gas temperature:
(both ignition circuits on)

max. ..... 950 °C (1740 ° F)
normal ..... 900 °C (1650 ° F)

Reading taken approx. 100 mm (3,93 in.) after exhaust flange.

Reading of the exhaust gas temperature has to be taken for certification to the latest requirements such as FAR or EASA has to be conducted by the aircraft manufacturer.



07131
fig. 15/2

d03189

12) Cooling system

12.1) Description of the system

See fig. 16.

The cooling system of the ROTAX 914 is designed for liquid cooling of the cylinder heads and ram-air cooling of the cylinders.

The cooling system of the cylinder heads is a **closed** circuit with an expansion tank and overflow bottle.

The coolant flow is forced by a water pump, driven from the camshaft, from the radiator to the cylinder heads. From the top of the cylinder heads the coolant passes on to the expansion tank (1). Since the standard location of the radiator (2) is below engine level, the expansion tank located on top of the engine allows for coolant expansion.

The expansion tank is closed by a pressure cap (3) (with pressure relief valve and return valve). At temperature rise and expansion of the coolant the pressure relief valve opens and the coolant will flow via a hose at atmospheric pressure to the transparent overflow bottle (4). When cooling down, the coolant will be sucked back

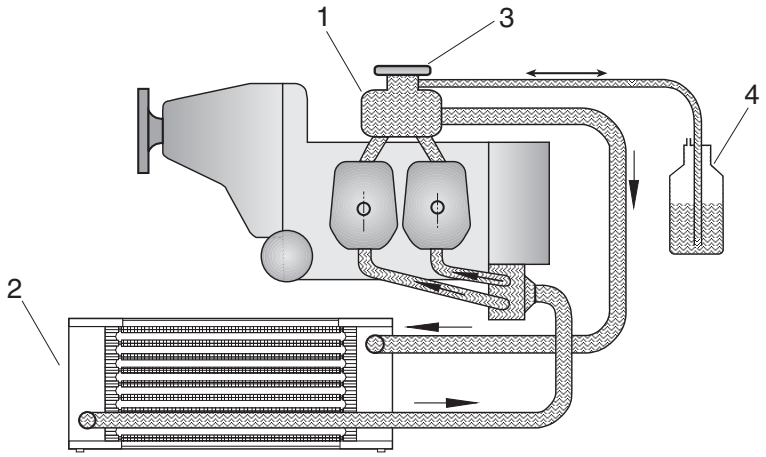


fig. 16

00125

into the cooling circuit. See therefore SB-914-025 "Modifications of the overflow bottle", latest issue.

The shape, size and location of one or more radiators depend mainly on the space available.

On good installation in the airplane the radiator has enough cooling capacity to keep the specified operating limits. Also the flow of coolant liquid through the radiator is not restricted.

No provision is made for attachment of the radiator(s) on the engine.

■ CAUTION: Install the radiator nondistorted and free of vibrations.

At installation of a non-original ROTAX radiator take care of sufficient cooling capacity. See chapter 12.7

d03190

12.2) Operating Limits

Using conventional coolant:

Coolant temperature: (coolant exit temperature)
max.....120 °C (248 °F)

Cylinder head temperature:

max.....135 °C (275 °F)

Permanent monitoring of coolant temperature and cylinder head temperature is necessary.

Using waterless coolant:

Cylinder head temperature:

max.....135 °C (275 °F)

Permanent monitoring of cylinder head temperature is necessary.

▲ WARNING: The cooling system has to be designed so that operating temperatures will not be more than the maximum values.

Monitoring the cylinder head temperature is important to control the engine cooling and prevents detonation within the operating limits. It is also necessary to design the cooling circuit so that under no conditions the coolant does get near its boiling point, because a subsequent loss of coolant can quickly cause the engine to overheat.

The boiling point of the coolant is influenced mainly by

- the type of coolant
- the proportion of the mixture (percentage water rate)
- the system pressure (opening pressure of radiator cap)

Correlation between coolant temperature and cylinder head temperature

There is in principle a regular relationship between coolant temperature and cylinder head temperature. The coolant transfers some of the combustion heat to the radiator. Thus, the coolant temperature is usually lower than the cylinder head temperature. But the temperature difference between coolant and cylinder head is not constant and can vary with different engine installation (cowling or free installation, tractor or pusher, flight speed, etc.).

◆ NOTE: The basic requirement for safe operation is that boiling of conventional coolant must be prevented. The boiling point of conventional coolant is 120 °C (248 °F) with a 50/50 mixture proportion and a system pressure of 1.2 bar (17.5 psi).

d03190

12.3) Coolant types

In principle, 2 different types of coolant are permitted.

Type 1:

- Conventional coolant based on ethylene glycol

Conventional coolant is recommended as it is commonly available and has a greater thermal heat transfer capability. Its limitation is its lower boiling point.

Conventional coolant should be used with a mixture of 50 % concentrate and 50 % water.

◆ NOTE: Some conventional coolant is available pre-mixed by the manufacturer. In this case do not mix with water, follow the manufacturers instructions on the container.

Conventional coolant with a rate of 50% water cannot boil at a temperature below 120 °C (248 °F) at a pressure of 1.2 bar (17.5 psi). Thus, the coolant temperature limit is at max. 120 °C (248 °F).

Permanent monitoring of coolant temperature and cylinder head temperature is necessary.

Type 2:

- Waterless coolant based on propylene glycol

Waterless coolant is recommended if the design of the aircraft can not maintain the coolant temperature limit. Waterless coolant has a very high boiling point that prevents coolant loss due to „boiling over“ (vapor loss), but not to prevent detonation, which can occur with cylinder head temperatures higher than 135 °C (275 °F). It does not require pressure to maintain its boiling point. Due to a lower thermal conductivity the engine temperature will typically run about 5-10 °C (41-50 °F) higher with waterless coolant.

Permanent monitoring of cylinder head temperature is necessary.

Additional monitoring of the actual coolant temperature is possible.

Marking of the coolant to be used

■ CAUTION: The coolant to be used and its concentration (percentage water rate) must be communicated to the owner in the correct form.

Waterless coolant must not mix with water, as otherwise to lose the advantages of the high boilling point.

Example: EVANS NPG+. See fig. 16/1.

1 Warning sticker
2 Radiator cap
3 Opening pressure information of radiator cap.

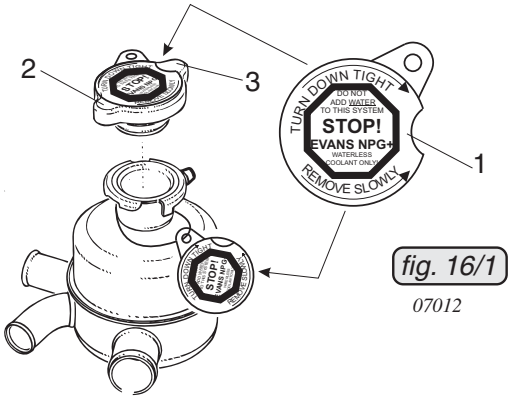


fig. 16/1
07012

d03190

12.4) Check cooling system - Efficiency of the cooling system

For a measurement of the cooling system the maximum values for coolant exit temperature and cylinder head temperature must be found. According to the current specifications.

12.4.1) Measurement of cylinder head temperature and coolant exit temperature

There are two temperature sensors (1) on the cylinder 2 and 3 for measuring the cylinder head temperature. During flight test the place with the highest cylinder head temperature must be found, this can vary with different engine installation (cowling or free installation, tractor or pusher, fight speed etc.).

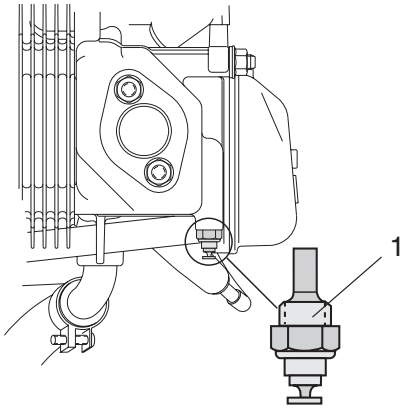


fig. 16/2
00327

The measuring of the coolant exit temperature is performed using a seperate sensor, which has to be installed in the line between expansion tank (1) and radiator inlet (2).

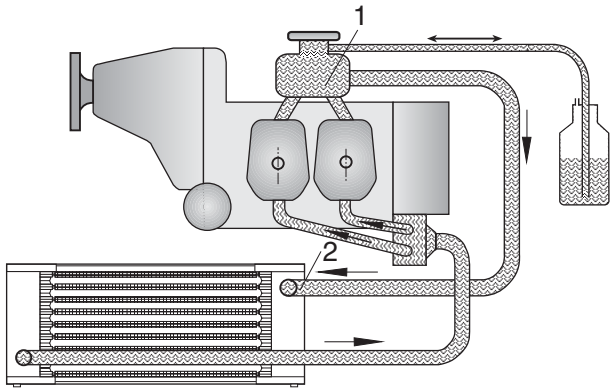


fig. 16/3
00125

The sensor may be installed in a „TEE“ inline with the fluid hose or the expansion tank may be modified to attach the sensor (not supplied by BRP-Rotax).

▲ WARNING: Do not restrict the coolant flow with the sensor devise.

■ CAUTION: It is possible to receive a misleading reading when measuring fluid temperatures. If fluid volume is lost and the probe is not fully submerged in the fluid the display could show a lower temperature than actual (measuring air temperature instead of fluid temperature).

d03190

12.5) Determination of operating limits, Coolant and necessary modification on radiator installation

Depending on the achieved maximum values of the cylinder head temperature and the coolant temperature following action are necessary.

07818

<table>
<tr><th colspan="2">maximum values for</th><th colspan="2">coolant used for tests</th></tr>
<tr><th>Coolant temperature</th><th>Cylinder head temperature</th><th>Conventional coolant</th><th>Waterless coolant</th></tr>
<tr><td>less than 120 °C (248 °F)</td><td>less than 135 °C (275 °F)</td><td>Additional instruments for displaying coolant temperature is necessary b)</td><td rowspan="2">Modifications to the instruments or limit not necessary a)</td></tr>
<tr><td>more than 120 °C (248 °F)</td><td>less than 135 °C (275 °F)</td><td rowspan="3">Cooling capacity too low. Check of the installation necessary c)</td></tr>
<tr><td>less than 120 °C (248 °F)</td><td>more than 135 °C (275 °F)</td><td rowspan="2">Cooling capacity too low. Check of the installation necessary c)</td></tr>
<tr><td>more than 120 °C (248 °F)</td><td>more than 135 °C (275 °F)</td></tr>
</table>

a) Maximum cylinder head temperature is below operating limit. Operating with waterless coolant, is permissible without modification to the installation.

b) Maximum cylinder head temperature and coolant exit temperature is below operating limit.

For operating with conventional coolant it is necessary to monitoring constantly cylinder head temperature and coolant exit temperature.

◆ NOTE: For detection of possible indication error an additional monitoring of the cylinder head temperature is necessary which shows an exceedance in case of coolant loss.

The aircraft manufacturer has the option of converting the coolant temperature and the cylinder head temperature to an aircraft specific cylinder head temperature. This is possible by calculating the difference between the head material and the coolant temperature.

This is done by following the flight test procedure on page 40.

Once the calculation is made and the indicating instrument re-labeled it is acceptable to use the cylinder head temperature as the primary cockpit display instead of installing a sensor in the coolant flow.

The measurement is based on the maximum coolant temperature and cylinder head temperature according to the current requirement.

■ CAUTION: In no case a cylinder head temperature higher than the limit of 135 °C (275 °F) can be defined because detonation could not be sufficiently prevented.

Refer to the flight test example that follows.

c) Cooling capacity of the installation too low.

d03190

Flight test example:

Calculated values (maximum values found for coolant temperature and cylinder head temperature. Refer to the current specification of the FAA and/or EASA):

Coolant temperature.....102 °C (216 °F)

Cylinder head temperature.....110 °C (230 °F)

The cylinder head temperature is 8 °C higher than the coolant temperature.

Thus:

Coolant temperature limit.....120 °C (248 °F)

Difference cylinder head and coolant temperature.....+ 8 °C (46 °F)

= 128 °C (262 °F)

The highest cylinder head temperature permitted is 128 °C (262 °F), so that the max. coolant temperature is kept.

With this special application, safe operation of the engine that prevents boiling of the coolant is possible up to a cylinder head temperature of 128 °C (262 °F).

■ CAUTION: This cylinder head temperature with the limit found for this type must be displayed constantly in the cockpit.

The indicating instrument and the manuals must be changed to cylinder head temperature max. 128 °C (262 °F).

■ CAUTION: The design of the radiator installation must be changed (example: cowl modifications), such that the operating temperature will not exceed the specified limits.

d03190

12.6) Requirements on the cooling system

■ CAUTION: All components of the cooling system have to secured siutably.

▲ WARNING: The size and layout of the cooling system must be designed to keep the operating temperatures within the specified limits.

To minimize flow resistance employ radiator with low flow resistance and parallel flow as realized on the original BRP-Rotax radiator and use short hoses and pipelines.

Coolant hoses:

- temperature durability: min. 125 °C (257 °F)
- pressure durability: min. 5 bar (73 p.s.i.)
- nom. inside dia : 25 mm (1")
- bending radius: min. 175 mm (7")
- material: Suitable for 100 % Glycol and antifreeze agents.

■ CAUTION: Pay CAUTION to ozone stability!

◆ NOTE: If installation require longer distances use aluminium pipes (25 mm (1") inside dia.) instead of hoses.

Expansion tank hoses:

- Hose for expansion tank must be rated for vacuum/suction for min. 125 °C (257 °F).

12.7) Size and position of connections

See fig. 17/18/19.

- expansion tank (1) with radiator cap (2)

to radiator (3):	outside dia. 25 mm (1")
slip-on length	max. 22 mm (7/8")
to overflow bottle (4):	outside dia. 8 mm (3/8")
slip-on length	max. 15 mm (9/16")

◆ NOTE: See therefore also SI-25-1997 "Running modifications", latest issue.

The aircraft manufacturer has to carry out the check of coolant level in the expansion tank and note it in the daily inspection section of his flight manual according latest issue of Operator's Manual ROTAX 914.

It is recommended to make adequate precautions for accomplishment of these inspections, e.g. a flap or panel on the cowling or a warning instrument in the cockpit for an under-shooting of the coolant level.

03190

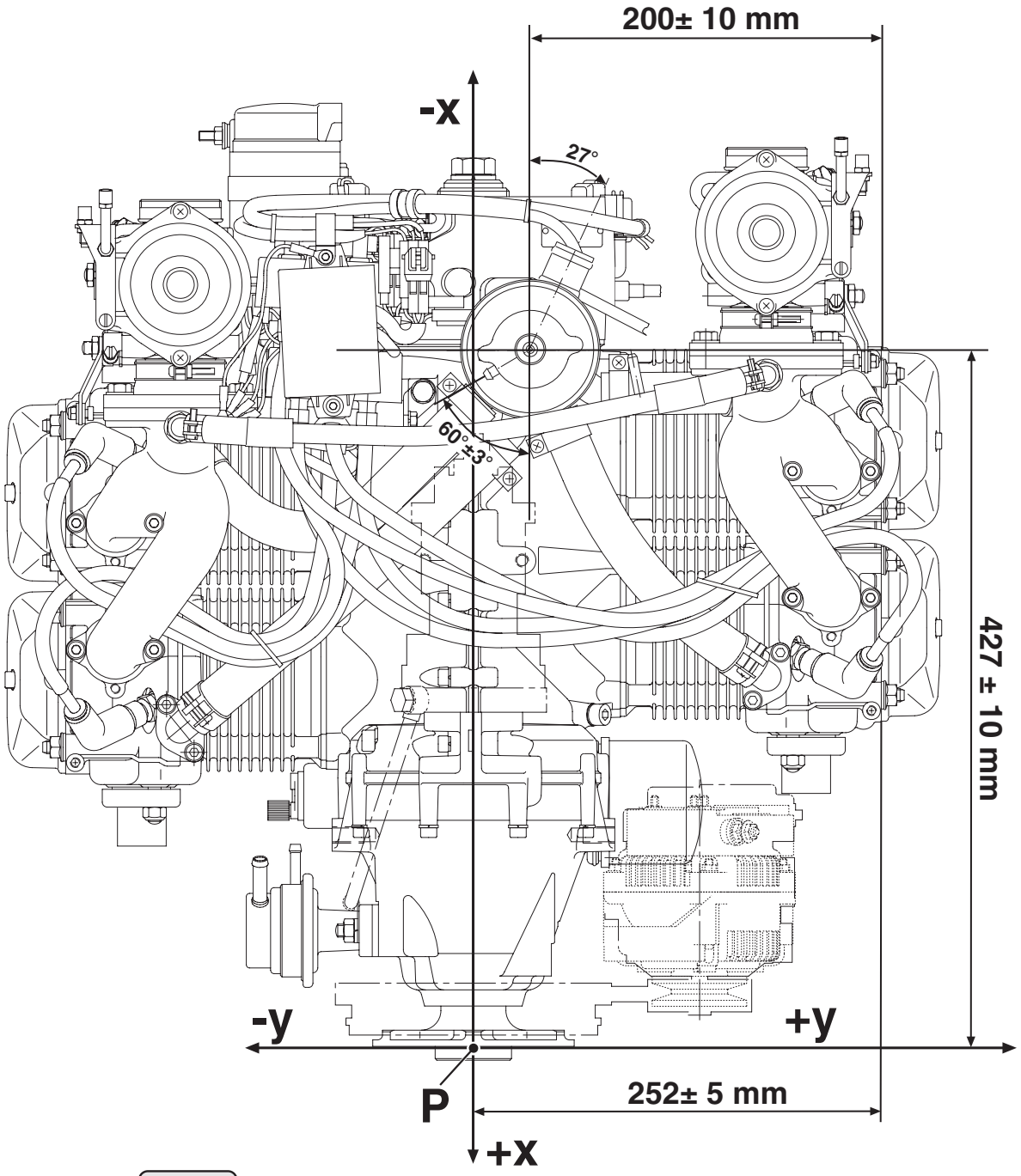


fig.17

07136

◆ NOTE: The picture shows ROTAX 912 Series, but the location of the expansion tank is identical as on ROTAX 914 Series.

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- water inlet bend (5): outside dia. 27 mm (1 1/16")
  slip-on length max. 19 mm (3/4")

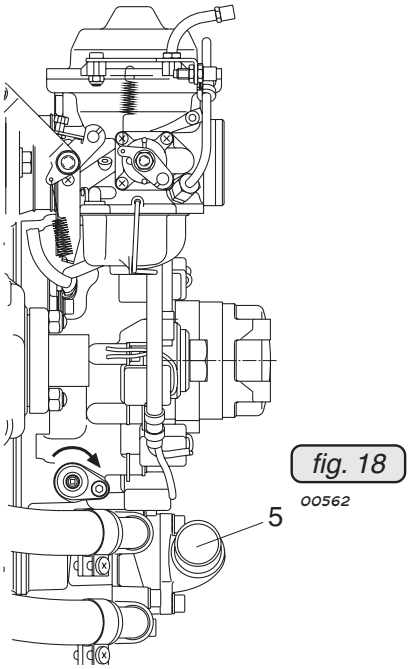


fig. 18
00562

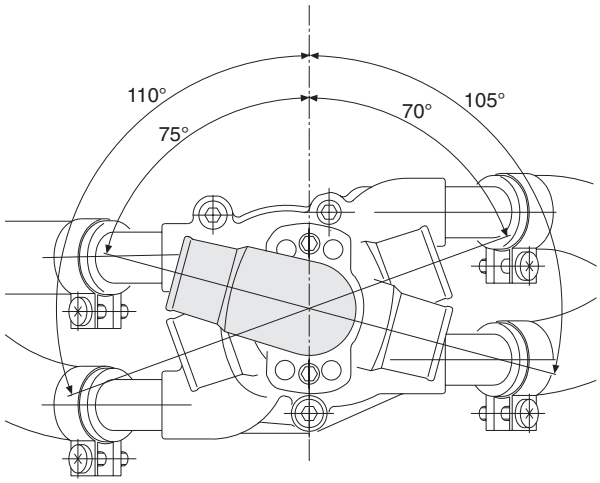


fig. 19
05536

◆ NOTE: Choose between six possible fitting positions of water inlet bend (5) appropriate to specific installation (see fig.).
The inlet bend is attached to the water pump by two Allen screws M6x20 and lock washers. Tighten screws to 10 Nm (90 in.lb.).

■ CAUTION: Utilize total slip-on length for hose connection. Secure hoses with suitable spring type clamp or screw clamp.

12.8) Coolant capacity

4 cylinder heads: ..... 560 cm^3

water pump: ..... 100 cm^3

expansion tank: ..... 250 cm^3

2 m coolant hose
(18 mm inside dia.) : ..... 500 cm^3

total coolant quantity in engine: ..... approx. 1,5 l (0.4 gal (US))

03190

12.9) Feasible location of radiator

See fig. 20.

The expansion tank (1) must always be positioned at the highest point of the cooling system.

■ CAUTION: If necessary, the radiator outlet opening (8) may be max. **1,5 m** (5 ft) above or below water inlet bend (5) on water pump (see fig. 20).

◆ NOTE: On the standard engine version the expansion tank (1) is fitted on top of the engine (see fig. 20).

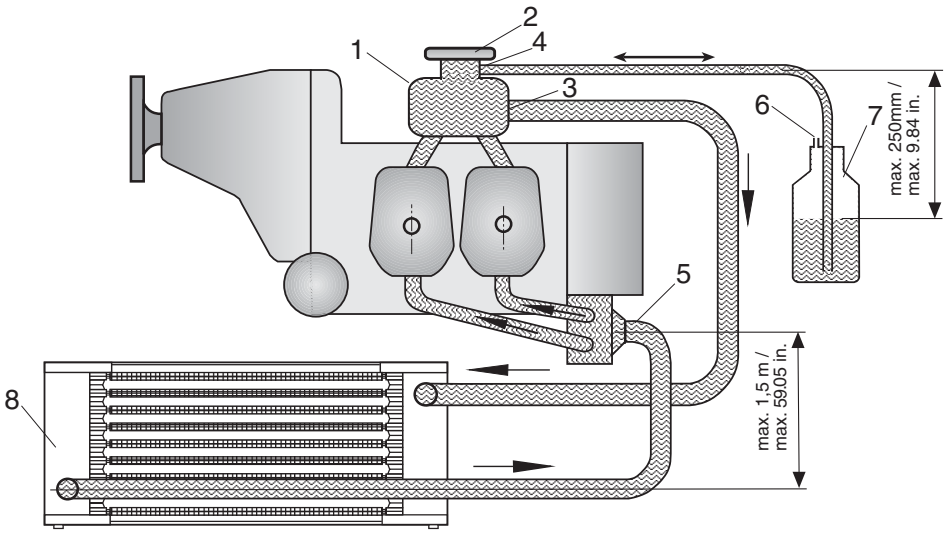


fig. 20

04872

For proper operation of the cooling system the expansion tank (1) with pressure cap (2) has to remain for all possible engine positions on the highest point of the cooling circuit.

▲ WARNING: The oil cooler has to be planned and installed such that the specified operating temperatures are maintained and the max. values are neither exceeded nor fall below.

This state has to be warranted for **"hot day conditions"** too!

If need be, take appropriate measures like changing size of cooler, partial covering of cooler etc.

Additionally the system needs an overflow bottle (7) where surplus coolant is collected and returned back into the circuit at the cooling down period.

◆ NOTE: For proper operation keep hose to overflow bottle as short and small as possible.

■ CAUTION: To warrant the proper operation of the cooling system the delivery head between overflow bottle and expansion tank must not exceed 250 mm (10").

03190

Requirements on the overflow bottle (7)

- transparent material
- unaffected by temperatures from - 40 °C (- 40 °F) to +125 °C (257 °F)
- resistant against 100% Glycol and any other anti freeze agent
- volume approx. 0,5 l (.13 US gal)
- possible to vent (6)

◆ NOTE: See therefore SB-914-025 "Modifications of the overflow bottle", latest issue.

◆ NOTE: The overflow bottle ought to be furnished with a label indicating function and content.

▲ WARNING: Ensure that the overflow bottle will never be empty, otherwise air will be sucked into cooling circuit with big effect to safe operation of the engine.

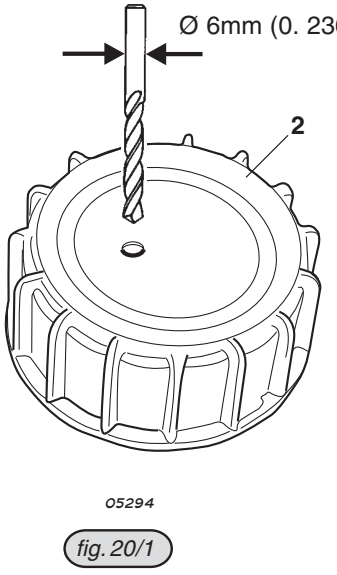
◆ NOTE: To enable an aimed drain of the leaking coolant steam from the expansion bottle in case of overheating, the plastic plug can be retrofitted with hose nipple and hose.

- Unscrew cap (2) from the overflow bottle.
- Bore the existing vent hole from dia. 1mm (0.04 in.) to dia. 6mm (0.236 in.)
- Apply LOCTITE® 603 to the threads of the hose nipple (3).
- Insert nipple (3) into the vent hole.
- Install nut (1) onto the hose nipple (3). Tightening torque 5 Nm (44 in lb).
- Screw the cap onto the overflow bottle.

Steps to attach the hose:

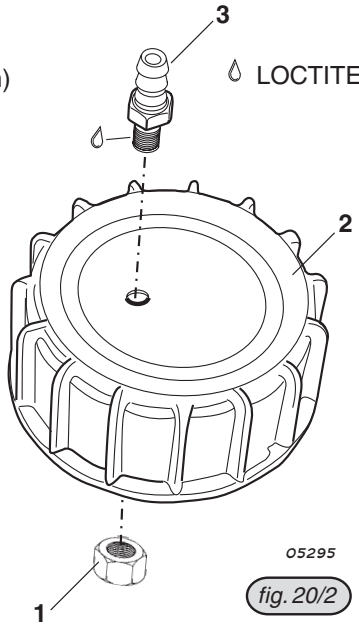
- Attach the hose with a gear-type hose clamp (4).
- Make sure the hose (5) has no kinks. Route it overboard and secure.

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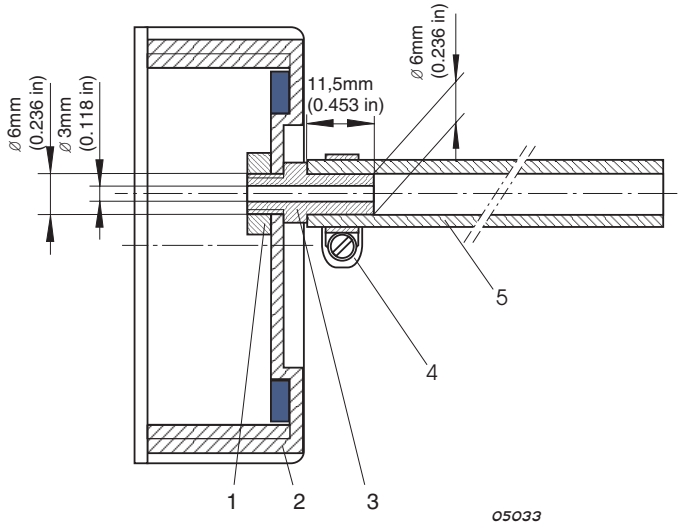
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fig. 20/1



05295

fig. 20/2



05033

fig. 20/3



05039

fig. 20/4

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12.10) General directives for the cooling system

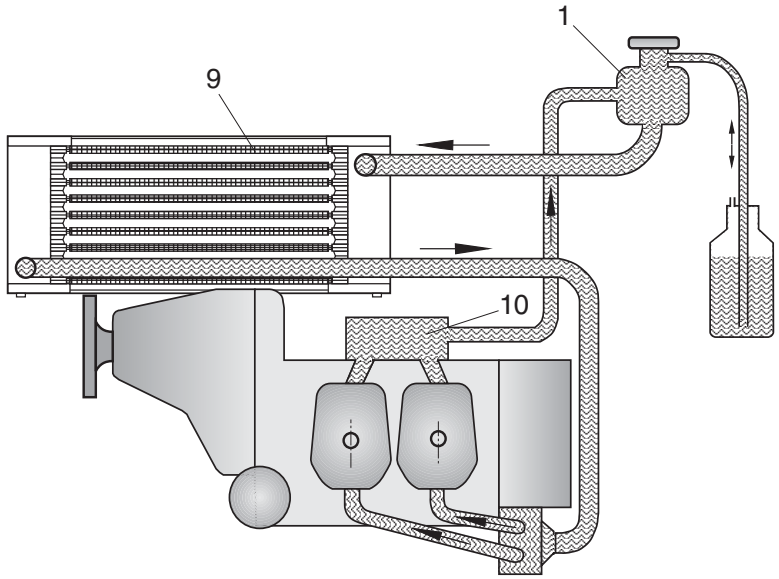
See fig. 21.

BRP-Rotax offers essential parts of the cooling system for this engine such as radiator, etc..

▲ WARNING: Certification to the latest requirements to FAR or EASA has to be conducted by the aircraft manufacturer.

fig. 21

04873



In an installation as depicted with the radiator (9) in a higher position than the standard supplied expansion tank, a water accumulator (10) has to fitted instead of the expansion tank. Additionally a suitable expansion tank (1) has to be installed at the highest point of the cooling circuit.

■ CAUTION: The size and type of radiator should be adequate to transfer thermal energy of approx. 30 kW (28 BTU/s) at take-off power.

◆ NOTE: Assessment data by experience. For troublefree operation at good airflow a radiator of at least 500 cm^2 (78 in^2) area has to be used.

The flow rate of coolant in the cooling system is approx. 60 l/min (16 US gal/min) at 5800 rpm. As reference value for the necessary cooling airflow approx. 0,75 m^3/s at full load can be assumed.

Check flow rate and cooling capacity if other radiators are used.

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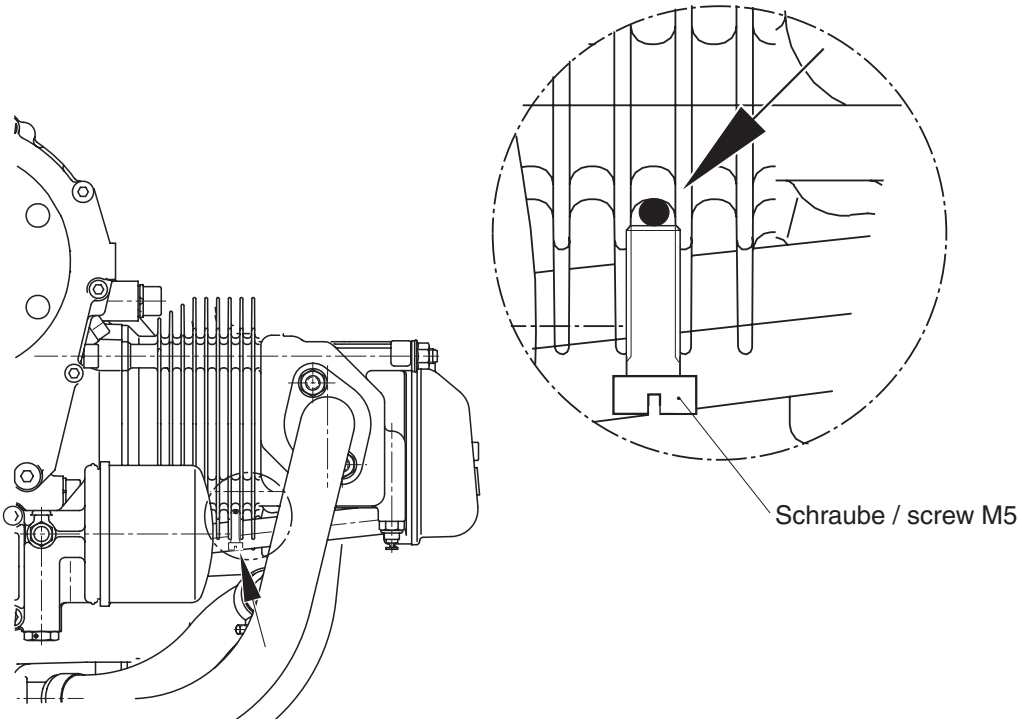
12.11 Cooling air ducting

Contrary to the cylinder heads, the cylinders are ram air cooled. Plan cooling air ducting according to installation requirement.

▲ WARNING: The cooling air ducting has to be designed and built such, that the operating temperatures are kept within the specified limits and maximum values are not exceeded.

This must also be warranted at "**hot day conditions**"!

Max. permissible cylinder wall temperature on cylinder 2 ..... 200 °C (392 °F) (see fig. 21/1)



02050

fig. 21/1

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12.11.1) General directives for ducting of the cooling air

See fig. 2/3/4.

For front installation in a closed fuselage, ducting of cooling air to the cylinders is recommended. In this case a costly horizontal partitioning can be avoided.

BRP-Rotax developed especially for this application a non-certified cooling air ducting.

to be conducted by the aircraft manufacturer.

The following recommendations should assist the aircraft manufacturer at the planning of a suitable cooling air ducting.

- The cooling air ducting to be adequate to transfer thermal energy of approx. 6 kW (5,7 BTU/s) at take-off power.
- required cross section of air duct: at least 100 cm^2 (16 in^2)
- material:
  glass fibre reinforced plastic or heat resistant non-inflammable material.
- attachment:
  formlocking on engine case and cylinders

◆ NOTE: In case formlocking attachment won`t be adequate, additional attachment is possible on two tapped lugs M8 on top side of engine.

■ CAUTION: The stated limit loads are valid only at utilization of min specified thread length, and must never be exceeded.

Depth of thread 18 mm (.71 in).

04864

	Axes		
	x axis mm (in.)	y axis mm (in.)	z axis mm (in.)
attachment points	-300 (-11.81 in)	-30 (-1.18 in)	-14 (-0.55 in)
	-300 (-11.81 in)	-30 (-1.18 in)	-14 (-0.55 in)

04876

	attachment points
max. allowable forces (limit load) in (N) in x, y and z axis	2 000
max. allowable bending moment (limit load) in (Nm) in x, y and z axis	50
min. length of thread engagement (mm)	15 (0.59 in)

03190

NOTES

13) Lubrication system

13.1) Description of the system

See fig. 22.

The ROTAX 914 engine is provided with a dry sump forced lubrication system with a main oil pump with integrated pressure regulator and an additional suction pump.

◆ NOTE: The oil pumps are driven by the camshaft.

The main oil pump sucks the motor oil from the oil tank (1) via the oil cooler (2) and forces it through the oil filter to the points of lubrication (lubricates also the plain bearings of the turbo charger and the propeller governor).

The surplus oil emerging from the points of lubrication accumulates on the bottom of crankcase and is forced back to the oil tank by the blow-by gases.

The turbo charger is lubricated via a separate oil line (3) from the main oil pump.

The oil emerging from the lower placed turbo charger collects in the oil sump and is pumped back by a separate pump to the oil tank via the oil line (4).

◆ NOTE: The oil circuit is vented via nipple (5) in the oil tank.

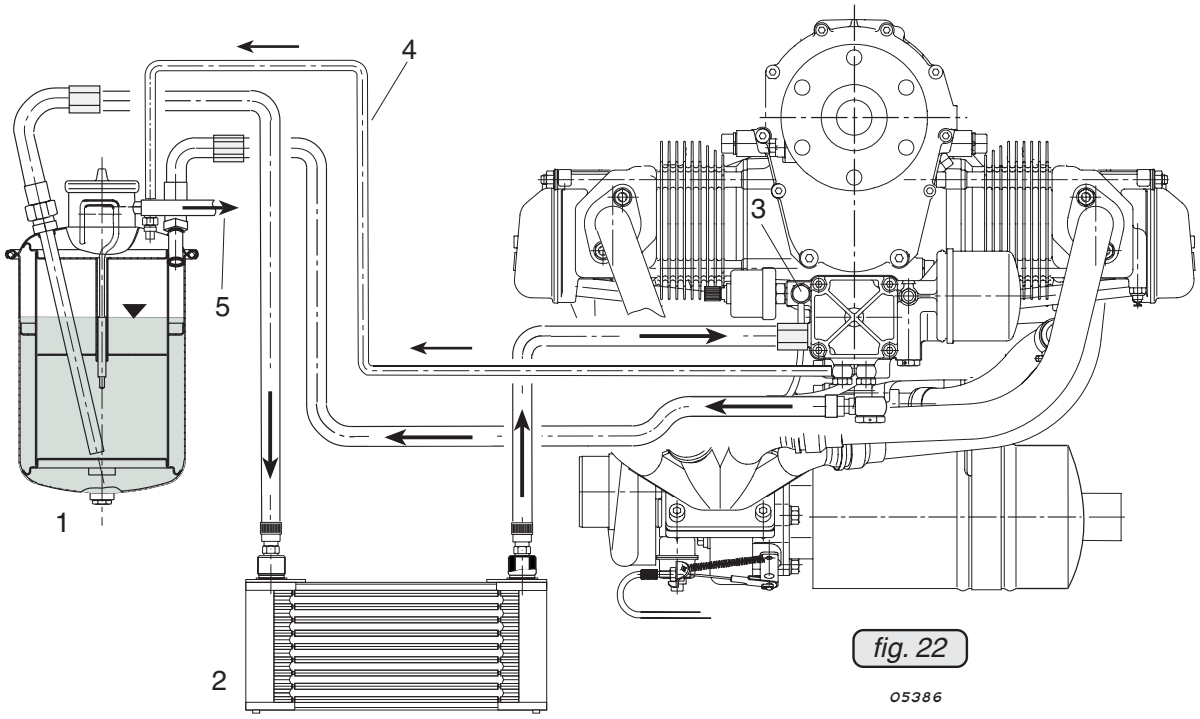


fig. 22

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For the completion of the lubrication system only the following connections need to be established:

Lubrication circuit engine (main oil pump)

oil tank (outlet) ➪ oil cooler

oil cooler ➪ oil pump (inlet)

oil return ➪ oil tank (inlet)

oil tank ➪ venting line

Oil circuit turbo charger (suction pump)

oil return ➪ oil tank (inlet)

◆ NOTE: In the serial version of the engine an oil tank is included, but no provision is made for attachment of an oil cooler.

▲ WARNING: Certification of oil cooler and connections to the latest requirements such as FAR and EASA has to be conducted by the aircraft manufacturer.

13.2) Limits of operation

▲ WARNING: The lubrication system has to be designed such that operating temperatures will not exceed the specified limits.

Oil pressure: For oil pressure sensor see fig. 75/76.

see OM 914 Serie, chapter 10.1

Oil temperature: Oil temperature sensor, see fig. 73/74.

see OM 914 Serie, chapter 10.1

▲ WARNING: At operation below nominal oil temperature formation of condensate in the lubrication system might influence oil quality.

◆ NOTE: For operation at low temperatures the installation of an oil thermostat, parallel to the oil cooler, is strongly recommended.

Advantages: safe oil pressure after cold start, prevention of fuel and water accumulation in the oil.

See therefore SL-914-009 "Use of an oil thermostat", latest issue.

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13.3) Checking of the lubrication system

To control the proper function of the lubrication system the following readings have to be taken on the running engine.

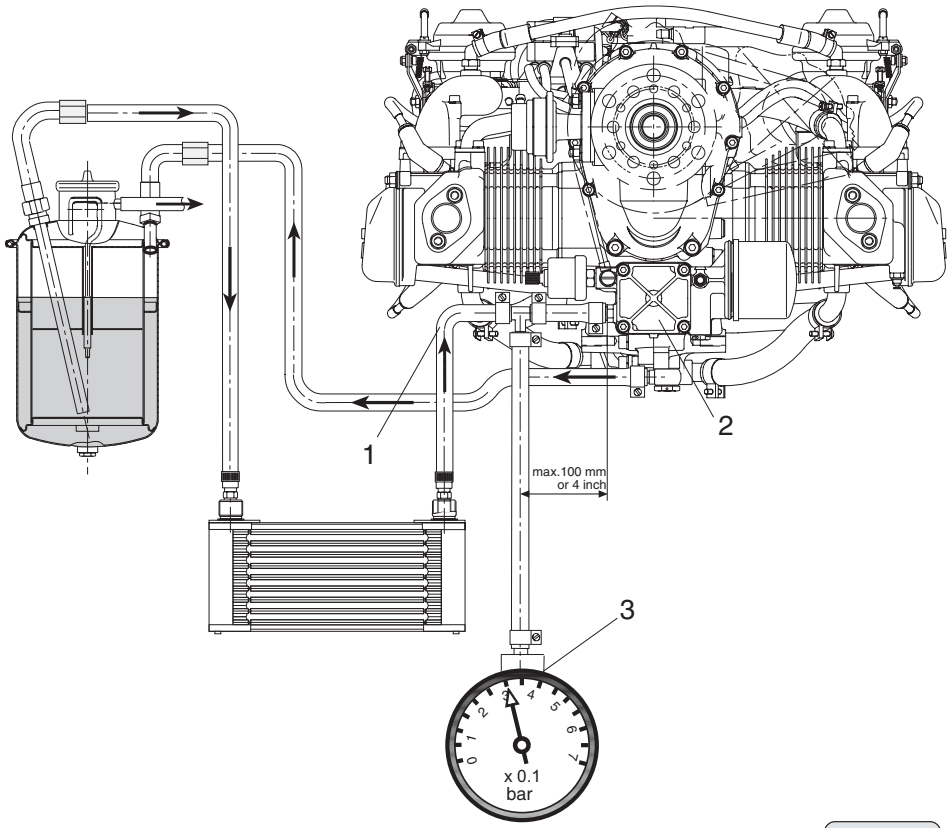
◆ NOTE: The required pressure gauges and connection parts are not included in the ROTAX engine delivery.

13.3.1) Measuring of the vacuum

Measuring of vacuum in the oil suction line (1) (line from oil tank to oil pump via oil cooler) at a max. distance of 100 mm (4 in) from pump inlet (2).

At take-off performance the indicated vacuum (3) must not be more than 0,3 bar (4,35 psi) otherwise the oil hose (1) could colapse and thus blocking the oil supply to the engine (fig 22/1).

▲ WARNING: The vacuum (3) must be verified over the total range of engine operation. Specially on cold oil temperature the flow resistance increases, so that not enough oil can flow on suction side.



03191

max. 0,3 bar Unterdruck

max. 0,3 bar below atmospheric pressure

fig. 22/1

04050

13.3.2) Measuring of the pressure in the crankcase

Measure of the mean crankcase pressure at full load (blow-by gas pressure) responsible for proper oil return from crankcase to oil tank.

A pressure indicator (4) (pressure gauge with incorporated viscous damper) may be fitted instead of the magnetic plug (5) or the crankshaft locking screw (6) (see fig. 22/2).

◆ NOTE: The connecting thread is M12x1,5 (metric) for the magnetic plug and M8 for the crankshaft locking screw (use always new gasket).

The pressure in the crankcase at full load must not exceed the prevailing ambient pressure by more than 0,45 bar (6,53 psi) at 90 °C (194 °F) oil temperature.

If both pressure readings are within the specified limits, under all operating conditions, the lubrication circuit should be working sufficiently.

▲ WARNING: If the readings exceed the pressure limits then the flow resistance of the oil backflow from oil sump to oil tank (contamination, restrictions of cross-section etc.) is too high. This condition is unsafe and must be rectified without delay.

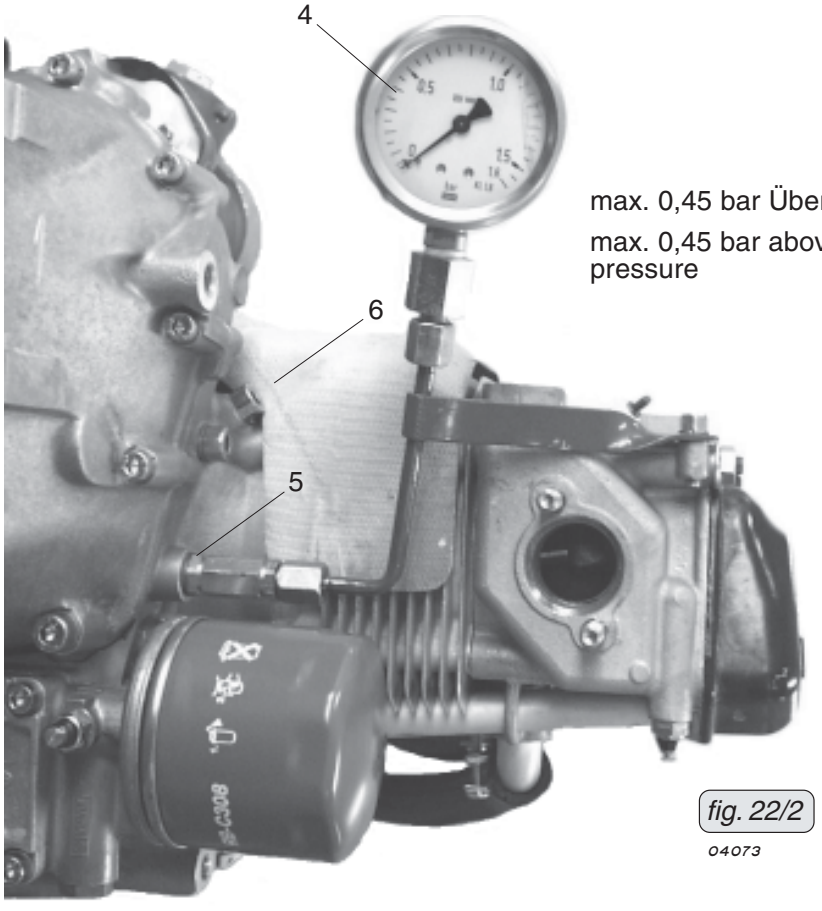


fig. 22/2

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13.4) Requirements on the oil- and venting lines

Oil lines

Oil circuit, engine (main oil pump)

- Temperature durability: mind. 130 °C (266 °F)
- Pressure durability: mind. 10 bar (145 p.s.i.)
- Bending radius: mind. 70 mm (2.75 in) *
  * unless otherwise stated by the hose manufacturer
- Minimum inside dia. of oil lines in reference to total length

  length up to ... 1m (3 '3") min. 11 mm ø (.43")
  length up to ... 2 m (6' 6") min. 12 mm ø (.47")
  length up to ... 3 m (10') min. 13 mm ø (.51")
- Length of a single oil line: max. 3 m (118,11 in.)

Oil circuit, turbo charger (suction pump)

- Temperature durability: mind. 130 °C (266 °F)
- Pressure durability: mind. 10 bar (145 p.s.i.)
- Bending radius: mind. 70 mm (2.75 in)*
  * unless otherwise stated by the hose manufacturer
- Minimum inside dia. of oil lines in reference to total length

  length up to ... 1m (3 '3") min. 6 mm ø (.23")
  length up to ... 2 m (6' 6") min. 7 mm ø (.27")

Vent line of oil tank

See fig. 22.

- Route the line without kinks and avoid sharp bends.

◆ NOTE: Water is a by-product of combustion. Most of this water will dissipate from the combustion chamber with the exhaust gases.

A small amount will reach the crankcase and has to be disposed through the vent line of oil tank via oil return line.

- The venting line must be routed in a continuous decline or furnished with a drain bore at it's lowest point to drain possible condensate.
- The vent line has to be protected from any kind of ice formation in the condensate. Protection by insulation, or routing in a hose with hot air flow or by furnishing vent line with a bypass opening (1) before passing through cowling (2). See fig. 23.

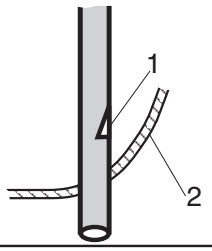


fig. 23

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13.5) Connecting dimensions and location of connections

■ CAUTION: Utilize the full slip-on length for hose connections. Secure hoses with suitable screw clamp or by crimp connection.

◆ NOTE: The oil pipeline connections are optional as UNF-thread. See SI-914-005.

13.5.1) Oil circuit (engine)

See fig. 24, 24/1 and 25.

Depending on engine certification, the oil pump inlet connectors can vary:

- 914 F ..... thread M18 - optional UNF-thread
- 914 UL ..... inlet nipple - optional M18 or UNF-thread

Oil pump (inlet) (1) ..... thread M18 x 1,5 x 11

◆ NOTE: Suitable for use of a swivel joint. See fig. 28.

Tightening torque: ..... 35 Nm (310 in.lb) and Loctite 243

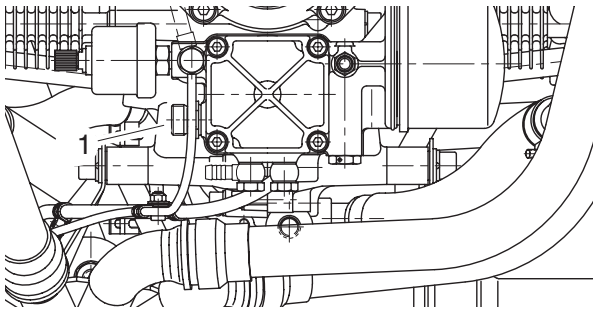


fig. 24

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Oil pump inlet nipple (1.1): outside dia ..... 13,2 mm (0.52 in.)

slip-on length ..... max. 21 mm (0.83 in.)

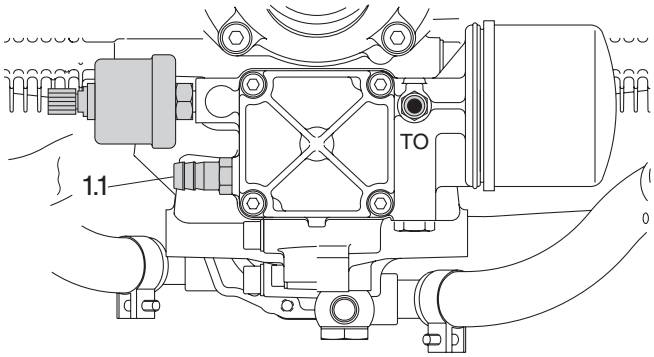


fig. 24/1

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Oil return

■ CAUTION: The engine design is for a conventional, non-aerobatic, fixed wing tractor or pusher type configuration with the oil return port in the optimum position. With this consideration the engine is properly lubricated in all flight profiles. Aircraft that are not conventional (e.g. airship, gyrocopters, dive brake equipped aircraft etc.) that require engine load in steeply incline and decline angles (see also chap. 8.1, point 12) may require special lubrication considerations.

According to propeller configuration choose the appropriate connection for the oil return line.
Position **1** for tractor or **2** for pusher configuration. See fig. 25.

hose nipple (2) ..... 10 DIN 7642
outside dia. ..... 13,5 mm (.53 in)
slip-on length ..... max. 24 mm (max. .94 in)

Tightening torque of banjo bolt (3) M16x1,5x28: ..... 35 Nm (310 in.lb)

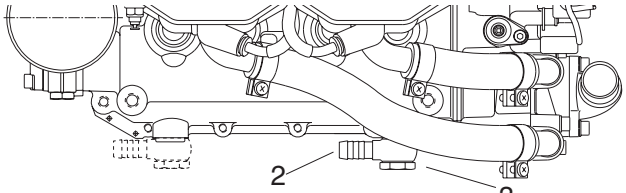


fig. 25

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13.5.2) Oil circuit (turbo charger)
See fig. 26.

Oil return

hose nipple (4) ..... 4/6 DIN 7642
outside dia. ..... 8 mm (.31 in)
slip-on length ..... max. 20 mm (.79 in)

Tightening torque of banjo bolt (5) M10x1x19: ..... 15 Nm (133 in.lb)

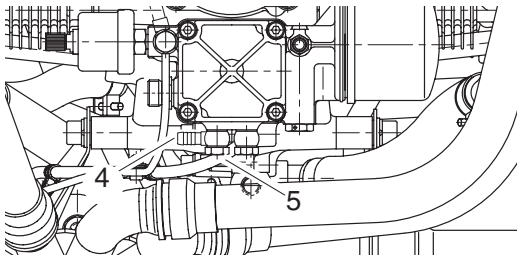


fig. 26

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13.5.3) Oil tank

See fig. 27/28.

The oil tank is furnished with 2 screw connections M18x1,5 and with a tapped hole (M10x1).

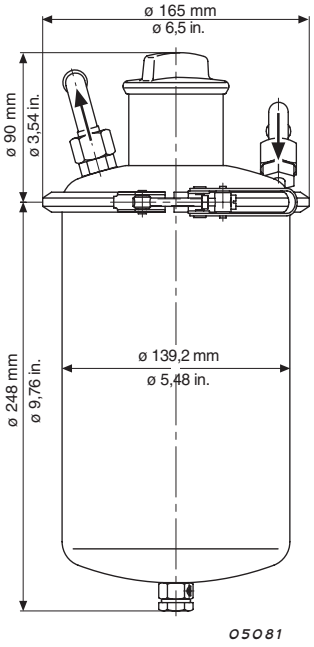


fig. 27

Connections for oil circuit (engine)

Oil inlet (6) and outlet (7) via standard swivel joint and connecting bend (8).

2x connecting bend 90° (8)

outside dia.	12 mm	(.47 in.)
slip-on length	max. 24 mm	(.94 in.)
tightening torque	25 Nm	(220 in.lb)

■ CAUTION: The oil tank cap is additionally marked with the term
IN - oil inlet (6) from crank case
OUT - oil outlet (7) to oil cooler/oit tank. See fig. 28.

1x venting nipple (9)

outside dia.	8 mm	(.31 in.)
slip-on length	max. 15 mm	(.59 in.)

Connection for oil circuit (turbo charger)

hose nipple (10) 4/6 DIN 7642

outside dia.	8 mm	(.31 in.)
slip-on length	max. 20 mm	(.79 in.)

tightening torque of the banjo bolt (11) M10x1x19: 15 Nm (133 in.lb)

◆ NOTE: In the standard supply volume the connection (12) is closed by the plug screw (13).

This screw plug has to be removed and is replaced by the hose nipple (10), sealing ring (14) 10x14 DIN 7603 and banjo bolt (11).

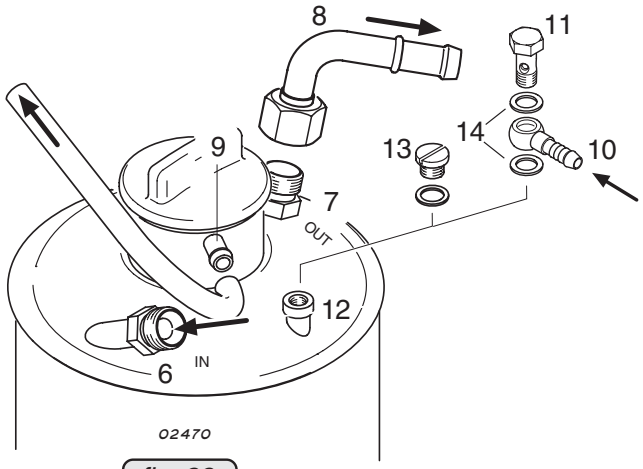


fig. 28

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13.6) Feasible position and location of the oil tank

See fig. 29.

- The longitudinal axis z3 to be parallel to z-axis of the system of coordinates. Tolerated deviation of parallelism: ± 10°

◆ NOTE: Above notice is valid for both planes.

The oil tank (1) has to be positioned in its z-axis such that the oil level (2) is always between 0 and -400 mm (-15.75 in.) on the z-axis .

▲ WARNING: At higher location of the oil tank oil might trickle through clearances at bearings into crankcase during longer periods of engine stop. If fitted too low it might badly effect the oil circuit.

- Install the oil tank free of vibrations.
- Oil tank cover (3) and oil drain screw (4) to be easily accessible.

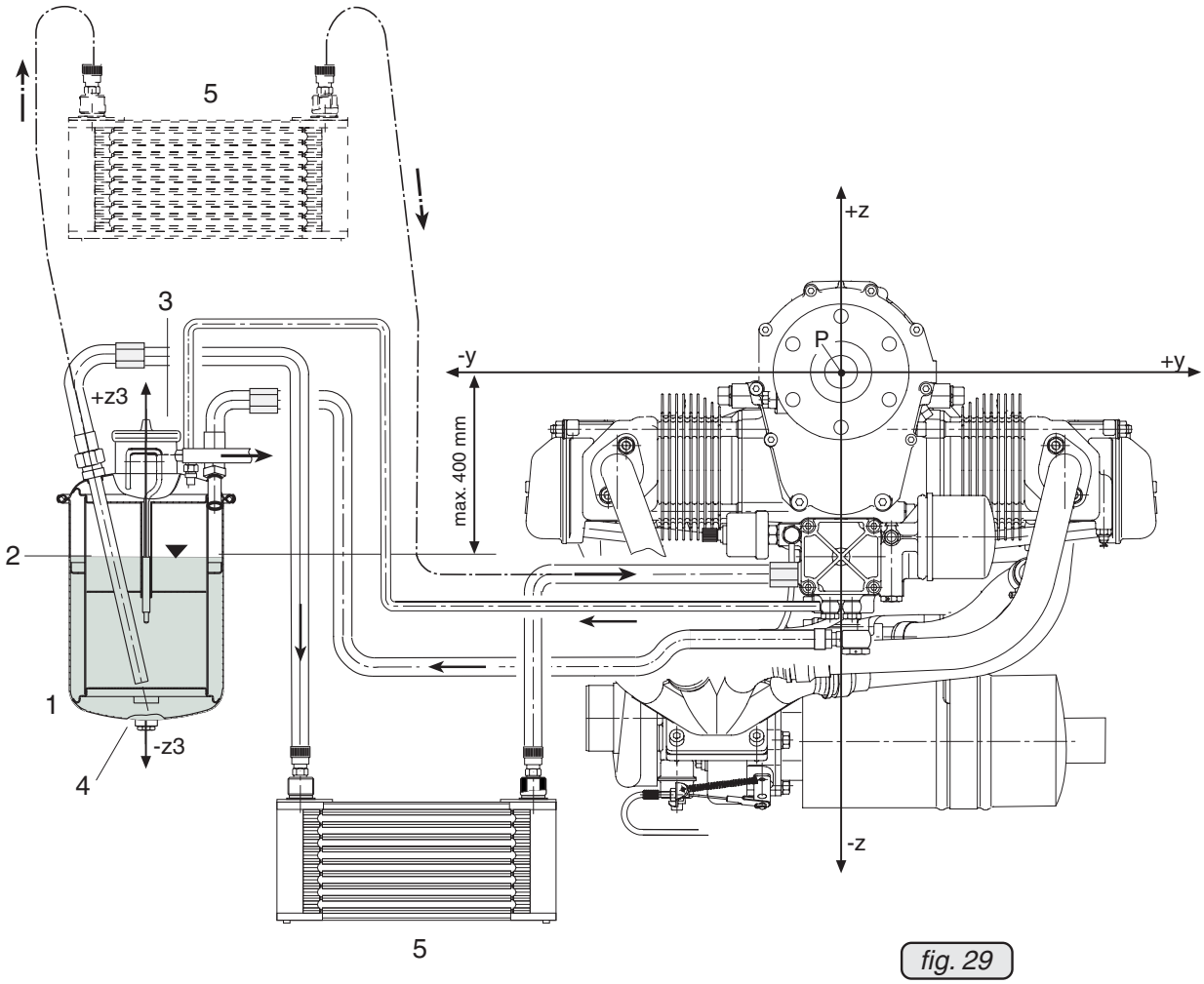


fig. 29

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03191

13.7) Feasible position and location of the oil cooler

See fig. 29.

- On principle the oil cooler (5) has to be installed below the oil pump of the engine.

■ CAUTION: The oil cooler has to be installed with connections upwards i.e. in positive direction on z-axis. This will prevent an unintentional draining of the oil cooler at longer engine stop.

- If this position is not practical, install also the oil cooler with connections upwards i.e. in positive direction on z-axis.

■ CAUTION: This will prevent an unintentional draining of the oil cooler at longer engine stop.

▲ WARNING: The oil cooler has to be planned and installed such that the specified operating temperatures are maintained and the max. values are neither exceeded nor fall below.

This state has to be warranted for **"hot day conditions"** too!

If need be, take appropriate measures like changing size of cooler, partial covering of cooler etc.

13.8) General notes on oil cooler

BRP-Rotax offers for this engine an oil cooler (see Illustrated Parts Catalog, latest issue).

▲ WARNING: Certification of this cooler to the latest requirements such as FAR or EASA has to be conducted by the aircraft manufacturer.

■ CAUTION: The oil cooler has to be designed to dissipate approx. 10 kW (8,5 BTU/s) heat energy at take-off power.

◆ NOTE: From years of experience we recommend an oil cooler size of at least 160 cm^2 (25 in^2), provided that air flow is adequate.

13.9) Filling capacity

- Oil quantity **without** oil cooler and connecting lines min. 3 l (0,8 US gal) depending on the respective installation

  Volume of oil tank

  up to the MIN.-mark ..... 2,5 l (0,66 US gal)

  up to the MAX.-mark ..... 3,0 l (0,8 US gal)

- Perform oil level check and add oil if necessary

03191

13.10) Venting (purging or priming) of lubrication system

(see fig. 29/1).

- Verify that oil tank connections are connected correctly and secured, and that the oil cooler is in the suction line(1) between the oil tank and the oil pump inlet. Verify that the oil tank is filled up to the maximum level (to the top of the flat portion of the dipstick). Additional oil must be added up to the MAX.-mark after this procedure.

◆ NOTE: Consult appropriate engine installation manual for diagrams to identify oil tank and oil pump connections. Older engines may be equipped with oil tanks that have oil ports differently located.

■ CAUTION: Incorrectly connected oil lines to the oil tank or to the engine will result in severe engine damage.

- Disconnect oil line (2) at the oil tank connection.
- Place the free end (3) of the return oil line into a suitable container (4) below the engine.
- Plug open connection (5) at the oil tank with suitable air tight cap. See fig. 29a.
- Remove the spark plug connectors.
- For easier rotation of engine remove the four top spark plugs.

■ CAUTION: Prevent entering of foreign substance through spark plug hole.

- Using a compressed air line, pressurise the oil tank through its breather connection (6) (on the neck of the tank). The air line pressure should be between 0,4 (6 psi) and 1 bar (15 psi) and not more than 1 bar (15 psi).

▲ WARNING: Do not remove oil tank or cover before ensuring that air pressure has been completely released from the tank.

- The pressure in the oil tank has to be maintained during the following step.
- Turn the engine in direction of normal rotation until the pressure rises on the oil pressure gauge. Normally this will take approx. 20 turns. Depending on installation it may take up to 60 turns.
- Release the pressure from the oil tank.
- Un-block the oil return port on (5) the oil tank and reconnect the engine return oil line (2) to the oil return port on the oil tank.

■ CAUTION: Ensure that the oil suction line (1) and engine oil return lines (2) are connected to the proper fittings on the oil tank. If the oil lines from the engine to the oil tank are incorrectly connected at the oil tank, severe engine damage may result.

- Add oil to engine oil tank to bring the oil level up to the full mark on the dipstick.

▲ WARNING: Carefully check all lubrication system connections, lines and clamps for leaks and security.

03191

13.10.1) Venting (purging or priming) of turbocharger lubrication system

▲ WARNING: Observe the appropriate safety precautions. Make sure that there are no foreign items including tools in the engine compartment. Secure aircraft to the ground appropriately and place chocks under the wheels. Secure propeller zone to warrant safety for persons and property. Be sure to approach only from engine side of propeller. Permanently supervise engine operation from a secure position. The cockpit must be occupied during the testing by a licensed pilot or an authorized person to conduct test runs of an aircraft.

To verify operation of the turbo charger oil circuit detach the turbo sump oil return line (7) on the oil tank (banjo bolt M10x1x19) and route the line to a separate container. Start the engine in accordance to the relevant Operators Manual and observe if oil is being returned back.

If oil is not flowing back within 10 sec. stop the engine immediately and find the trouble. Repeat previous steps until proper oil flow is observed.The engine must not be started before rectification.

Fit the turbo sump oil return line (7) on oil tank and tighten to 15 Nm (133 in.lb).

- Restore aircraft to original operating configuration.

13.11) Inspection for correct venting (priming) of hydraulic valve tappets

(See fig. 29/2)

The subsequent check procedure describes the correct method to verify adequate priming of hydraulic valve tappets.

■ CAUTION: Engine has reached operating temperatures here. Use appropriate safety equippment and clothing.

- Remove valve cover on cylinder 1.
- Turn crankshaft direction in of normal rotation so that the piston on cylinder 1 is on ignition top dead center, both valves are closed.
- Press both rocker arms on hydraulic valve tappet side with a force F (about 70 N (15.7 LB of force)) for about 3 sec.. Approximate force can be verified with a fan belt tester.
- Check distance between rocker arm and valve contact surface. Max. allowable distance 0,5 mm (0,02 in.).
- Repeat on all other cylinders.

■ CAUTION: If it is possible to push the valve tappets further than this limit, refit the valve covers and perform an additional engine run for about 5 min. at 3500 rpm. To get the hydraulic valve tappets adequately primed, this process can be repeated up to 2 times.

03191

13.12) Replacement of components

If a malfunction of hydraulic valve tappet should be found during this check of priming process, the relevant hydraulic valve tappet has to be replaced and the valve spring support has to be inspected for wear.

All work has to be performed in accordance with the relevant Maintenance Manual.

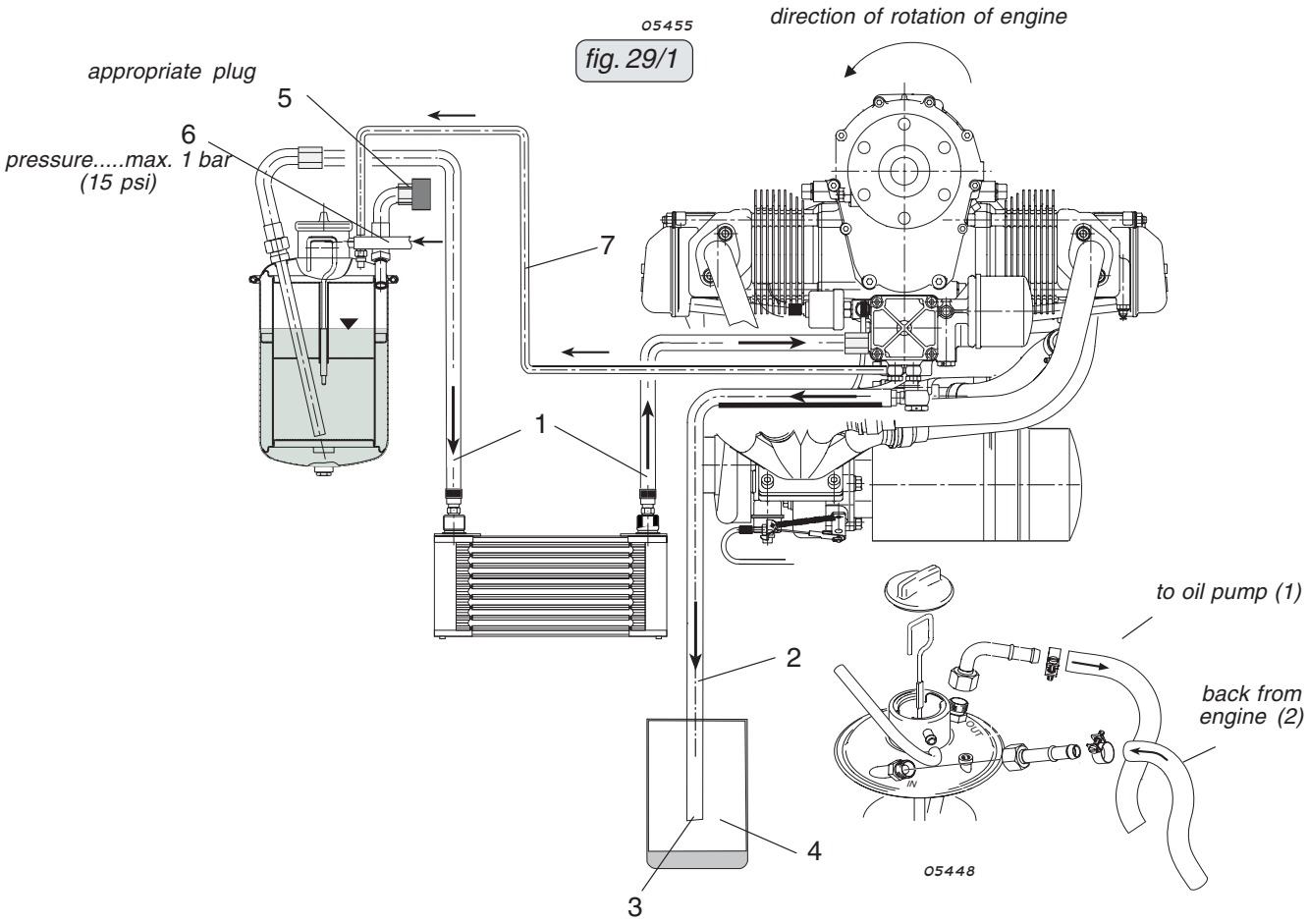


fig. 29/1

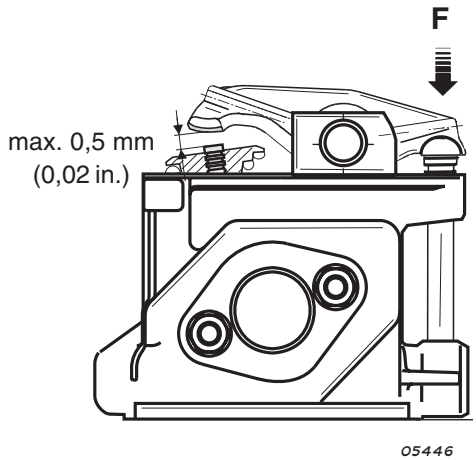


fig. 29/2

03191

NOTES

14) Fuel system

14.1) Description of system

See fig. 30.

The fuel flows from the tank via a coarse filter/water trap (1) to the two electric fuel pumps (2) with 2 check valve (6) connected in series. From the pumps fuel passes on via the fuel pressure control (3) to the two carburetors.

Via the return line (5) surplus fuel flows back to the fuel tank and suction side of fuel system.

◆ NOTE: The fuel pressure control ensures that the fuel pressure is always maintained approx. 0,25 bar (3,6 p.s.i.) above the variable boost pressure in the "airbox" and thus ensures proper operation of the carburetors.

On the standard version of the engine the fuel lines from fuel pressure control to the carburetors are already installed.

The fuel system from tank to the fuel pressure control has to be installed by the aircraft manufacturer.

<u>The fuel system includes the following items:</u>

- tank
- coarse filter
- fine filter / watertrap
- fuel shut off valve
- 2 electric fuel pumps
- as well as the required fuel lines and connections

<u>legend:</u>

(1) fine filter / watertrap / gascolator
(2) 2 x electric fuel pump
(3) fuel pressure control
(4) feeding line from tank
(5) return line to tank
(6) 2 x check valve

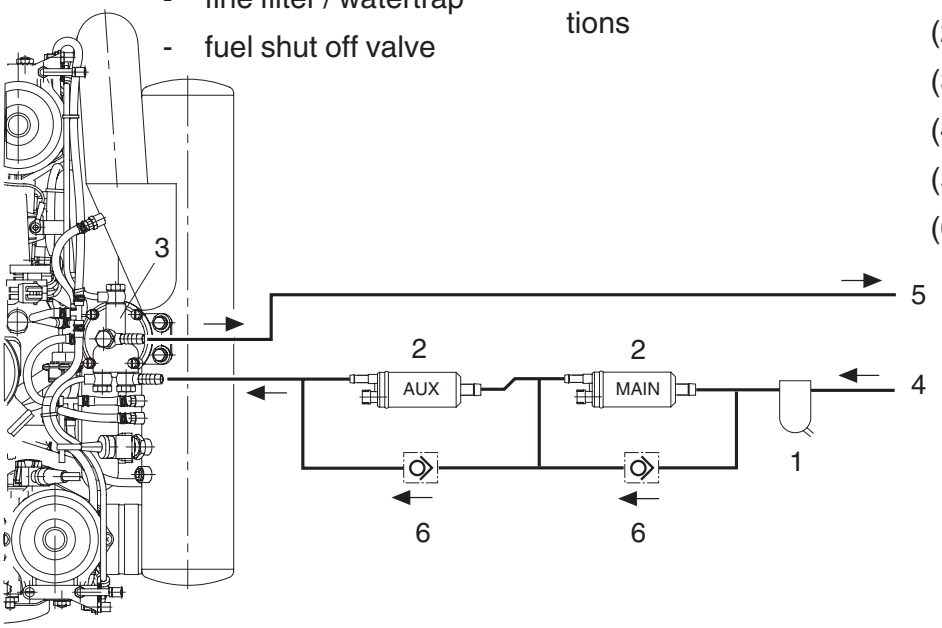


fig. 30

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<u>Only the following connections per fig. 30 have to be established:</u>

- Feeding lines to suction side of the electric fuel pumps (2)
- lines from pressure side of the electric fuel pump to inlet of fuel pressure control (3)
- Returnline from fuel pressure control to fuel tank

d03192

14.2) Operating limits

▲ WARNING: Design and layout of the fuel system has to warrant engine operation within the specified limits.

Fuel pressure:

max. ..... airbox pressure + 0,35 bar (5 p.s.i.)
min. ..... airbox pressure + 0,15 bar (2,2 p.s.i.)
nominal. ..... airbox pressure + 0,25 bar (3,6 p.s.i.)

The fuel pressure of the electric fuel pump must not exceed the manifold pressure by more than 0,35 bar (5 p.s.i.)

▲ WARNING: Fuel pressure in excess of stated limit can lead to an override of the float valve with subsequent engine stop.

◆ NOTE: On the standard engine no connection is provided for measuring the fuel pressure. Refer to chapter 14.5.

14.3) Requirements of the fuel system

- **Fuel lines:** See fig. 30.

▲ WARNING: Fuel lines have to be established to the latest requirements such as FAR or EASA by the aircraft manufacturer.

■ CAUTION: The fuel return (5) must be a line of low flow resistance. Max. tolerated pressure loss is **0,1 bar** (1,5 p.s.i.) between fuel pressure control and tank inlet with **both** electric fuel pumps in action. Otherwise the carburetors could flood.

Secure fuel hoses with suitable screw clamps or by crimp connection.

■ CAUTION: For prevention of vapour locks, all the fuel lines on the suction side of the fuel pump have to be insulated against heat in the engine compartment and routed at distance from hot engine components, without kinks and protected appropriately.

At very critical conditions e.g. problems with vapour formation the fuel lines could be routed in a hose with cold air flow.

- **Fuel filter:** See fig. 30.

  Coarse filter: on fuel tank as per valid certification

  Fine filter: in the feed line from tank to the 2 fuel pumps an additional fine filter with meshsize 0,1 mm(.004 in.) has to be provided.

  The filter has to be controllable for service. A combination of filter/ watertrap (gascolator) is recommended.

- **Fuel temperature:**
  In case of temperatures over 45 °C (113 °F) in the vicinity of fuel lines watch for vapour lock.

  If you should encounter problems in this respect during the test period, than the affected components such as the supply line to the fuel pumps have to be cooled.

d03192

14.4) Connecting dimensions, location of joints and directives for installation

14.4.1) Electric fuel pump

See outline of fuel pump (2), fig. 30, 31 and 32.

Design: self priming vane pump

Volume of supply: electric fuel pump with attachment kit, 2 hose clamps and various attachment elements

Weight: 0,35 kg (.8 lb) inclusive attachment items

Fitting position: horizontal or vertical

Engine start, operating temperature: -25 °C(-13 °F) - 50 °C(120 °F)

Connections: See fig. 31.

Inlet (1) (suction side)

Outlet (2) (pressure side)

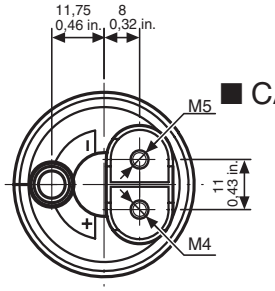


fig. 31

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■ CAUTION: Utilize the complete slip-on length on all hose connections. Secure fuel hoses with suitable spring type clamp or screw clamp.

Delivery rate/pressure : See diagram fig. 32.

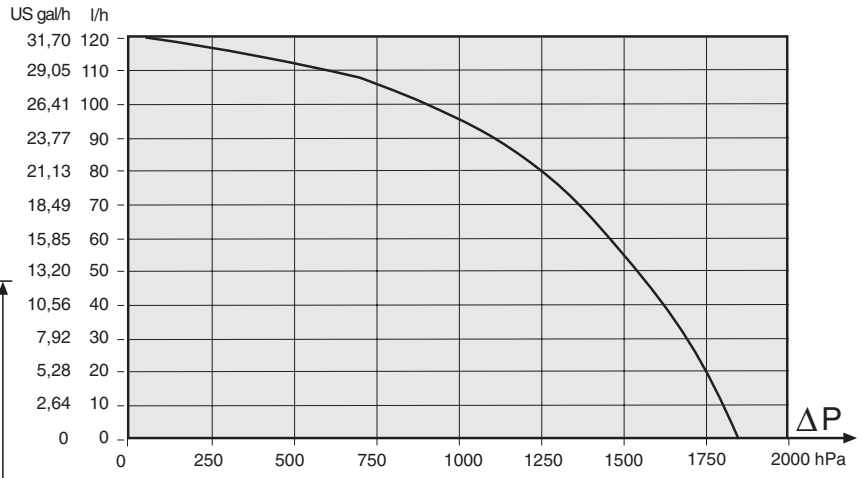


fig. 32

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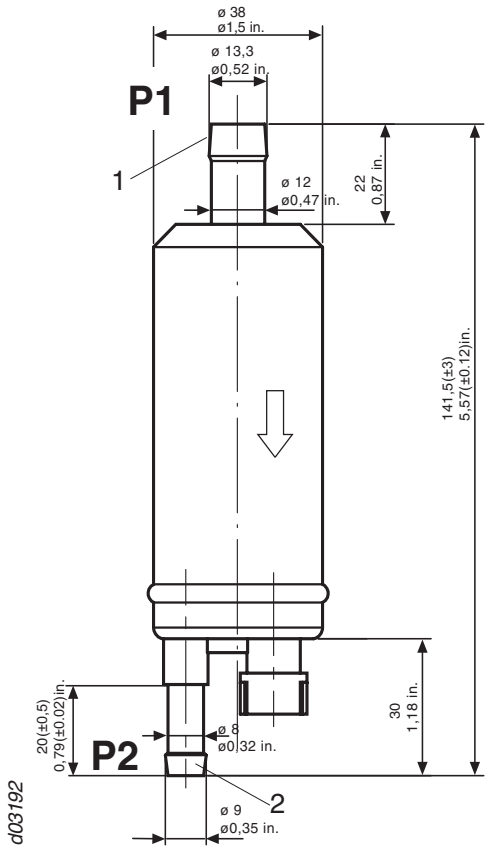
$\Delta P = P2 - P1$

The diagram shows the delivery rate of the electric fuel pump over pressure.

Take note of the following:

- diagram outlines min. capacity at nominal voltage on pump
- pressure and suction head are "ZERO"
- graph is effective on the seasoned pump only, running-in period approx. 30 min.

◆ NOTE: A capacity increase of approx. 20% is feasible by running-in process.



d03192

■ CAUTION: Employ GENUINE-ROTAX fuel pumps only. Non-compliance will release BRP-Rotax from any liability.

Place of installation:

- Installation of the fuel pumps principally near the fuel tank to gain advantage of a cool location, especially important at tendency of vapour locks.
- Install the pump in low position, if possible below fuel tank, free of vibrations. Therefore, fuel pump attached directly on the engine is not permitted.

  Max. suction head 250 mm (10 in).

▲ WARNING: Certification to the latest requirements such as FAR or EASA has to be conducted by the aircraft manufacturer.

Because of the risk of steam vapour formation on the suction side of the pumps and other safety reasons is the pump installation not permitted in the engine compartment.

▲ **WARNING: Installation of the fuel pumps in the engine compartment and in the cockpit is not permitted since the fuel pumps are not of a fire resistant construction.**

▲ WARNING: Should the situation arise, certification to the latest requirements such as FAR or EASA would have to be conducted by the aircraft manufacturer.

Check valve

Specification:

opening pressure	0,1-0,15 bar (1,5 p.s.i. - 2,2 p.s.i.)
permitted pressure in reverse-biasing	2 bar (29 p.s.i.)
burst pressure	5 bar (72,5 p.s.i.)

d03192

14.4.2) Fuel pressure control

See outline of fuel pressure control (3), fig. 30 and fig. 33.

Connections: **inlet (1)** (feed line from fuel pumps) and

outlet (2) (fuel return to tank)

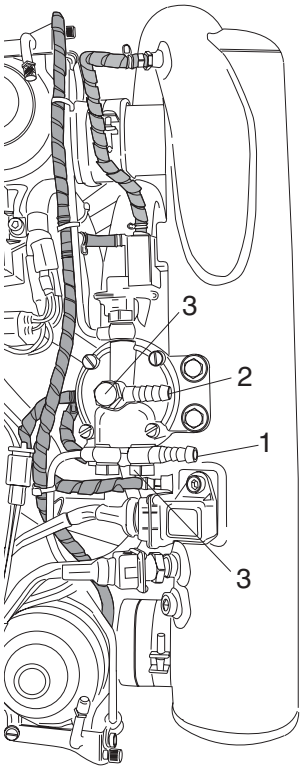
hose nipple 4/6 DIN 7642
outside dia. ø ..... 8 mm (5/16")
slip-on length ..... max. 20 mm (3/4")

tightening torque of the
banjo bolts ❸ ..... M10x1x19: 15 Nm (133 in.lb)

■ CAUTION: Utilize the full slip-on length at hose joints. Secure hose with suitable screw clamp or by crimp connection.

◆ NOTE: The control of the fuel pressure is achieved by a valve activated from a diaphragm. Reverence pressure is the boost pressure in the airbox.

Any **arrows** shown on top of the fuel pressure control are of no significance for this application.



05740

fig. 33

14.5) Notes on checking of fuel pressure

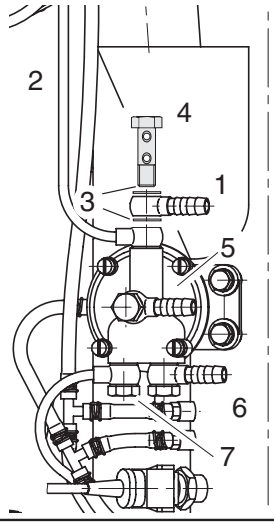
See fig. 34.

There is no standard connection provided to measure the full pressure. For general observation and at engine troubles fuel pressure readings would be helpful.

A feasible connection would be an additional hose nipple 4/6 (1) joined to the fuel line (2).

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fig. 34



d03192

- remove banjo bolt M10x1x19. Fit additional hose nipple (with integrated orifice) (1) and 2 sealing rings (3) by use of a longer banjo bolt (4) M10x1x30.

  Tightening torque of the banjo bolt: 15 Nm (133 in.lb).

■ CAUTION: At tightening of the fuel lines (2) support the specific line, to prevent any internal stresses.

◆ NOTE: The fig. 34 shows the additional ring hose nipple connected to fuel line of carburetor 1/3 (1). This ring hose nipple may be also fitted on the fuel line 2/4 (7), but not on the **outlet** (5) and inlet (6).

All the necessary items are available as spare parts.

NOTES

15) Carburetor

See fig. 35.

The carburetors on the standard engine are already attached by a flexable flange. Only connections of the Bowden cable for throttle and starting carb have to be established.

It is recommended, to make the adjustment of the Bowden cable after engine installation has been completed, to ensure exact final adjustment.

■ CAUTION: In case this has not been taken care of, verification of the throttle position is required prior to the trial run. Refer to chapter 15.5.

15.1) Requirements on the carburetor

The carburetors are positioned above the exhaust sockets. Below the carburetors one each drip tray (1) with a draining connection (2) is fitted which acts as heat shield as well.

▲ WARNING: In the area of the float chamber the temperature limit of the fuel must not be exceeded.

If need be provide additional insulation or heat shields. Certification to the latest requirements such as FAR or EASA has to be conducted by the aircraft manufacturer.

Drainage piping

▲ WARNING: Connect draining lines without fail, otherwise emerging fuel from a possible leakage could drip onto the exhaust system. RISK OF FIRE!

- The lines have to be routed such that in case of a damage the surplus fuel is drained off suitably.
- Route the lines without kinks and avoid tight bends
- Route the lines with a continuous decline.
- The lines have to be protected against any kind of blockage e.g. by formation of ice.

■ CAUTION: With closed or blocked leakage piping, fuel could end up on exhaust system. RISK OF FIRE!

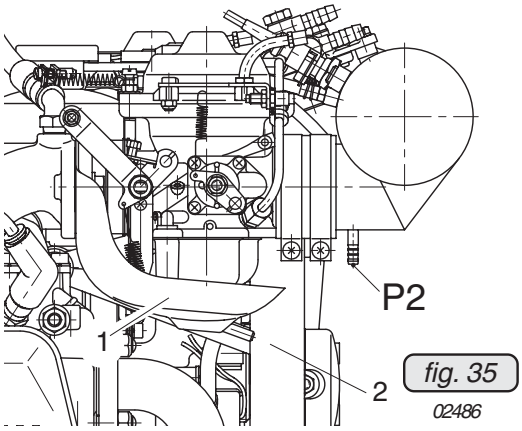


fig. 35

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Connecting nipple (2) for leakage line

outside dia. ø ..... 6 mm (1/4")
slip on length . max. 17 mm (11/16")

d03193

15.2) Connections for Bowden-cable actuation and limit load.

See fig. 36/37.

- connection for throttle actuation (1)

connection on throttle lever:	set screw M 5x12 tightening torque: 4 Nm (35 in.lb) (suitable for 1,5 mm (.06 in.) steel wire)
action travel:	65 mm (2 $^{1}/_{2}$")
actuating force:	min. 1,5 N (.3 lb) max. 8 N (1,8 lb)
limit load:	20 N (4,5 lb)

◆ NOTE: Throttle opens by spring.

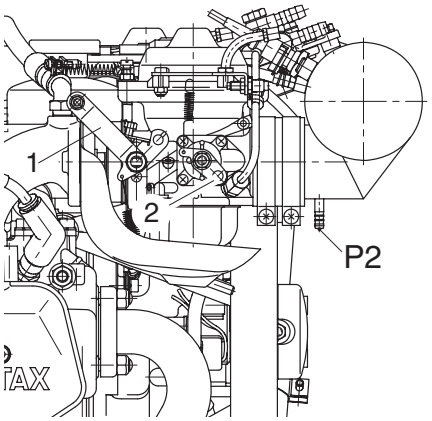
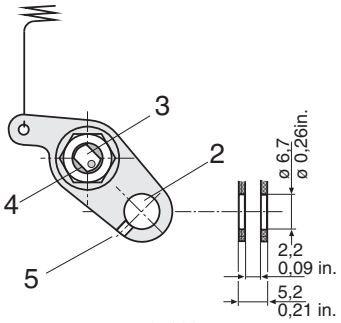


fig. 36 02486



05089

fig. 37

- connection for starting carb (choke) actuation (2)

connection on choke lever:	clamping nipple 6 (suitable for 1,5 mm (.06 in.) steel wire)
action travel:	23 mm ($^{15}/_{16}$")
actuating force:	min.10 N (2,2 lb) max. 45 N (10 lb)
limit load:	100 N (22 lb)

Directive for choke actuation

The choke shaft (3) is marked (4). This mark has to point towards cable engagement (5).

d03193

15.3) Requirements on cable actuation

See fig. 38.

The two throttles have to be controlled by two separate Bowden cables working synchronously.

Adjust the cables to a free travel of 1 mm (.04 in).

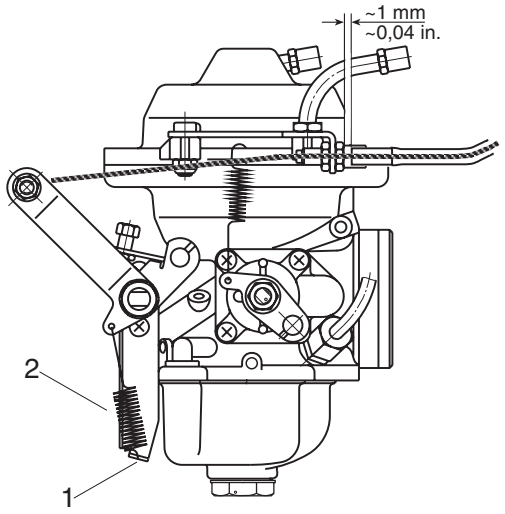


fig. 38

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▲ WARNING: With throttle lever not connected the carb will remain fully open. **The home position of the CD-carburetor is full throttle!**

Therefore never start engine without connecting throttle lever first.

▲ WARNING: Route Bowden cable in such a way that carb actuation will not be influenced by any movement of engine or air frame, thus possibly falsifying idle speed setting and carb synchronisation.

Adjust Bowden cable such that throttle and choke can be fully opened and closed.
Use Bowden cable with minimized friction so that the spring on the throttle can open the throttle completely. Otherwise increase pretension of spring by bending lever flap (1) or fit a stronger return spring, (2) or a cable with pull-push action would have to be used.

d03193

15.4) Requirements on the throttle lever

See fig. 39.

From throttle position 108 to 110 % the boost pressure rises rapidly and the throttle becomes very sensitive in this range. Therefore try to prevent operation in this small range or if setting for take-off performance pass this range quickly.

Consult also the chapter "electric system" for the description of the system.

For this reason it is recommended to assist the pilot with an visual/manual arrangement at setting for max. cruise performance.

A detent on your throttle lever at max. continuous power would be most suitable. Provide this detent at throttle position 104% corresponding to 8 - 9 mm (5/16" - 11/32") travel before full throttle stop.

The sketch (fig. 39) depicts a feasible arrangement.

The throttle lever is pressed onto throttle gate and comes to a stop at max. continuous power. Against the spring force the throttle lever will be released from the detent and can be moved further to take-off performance.

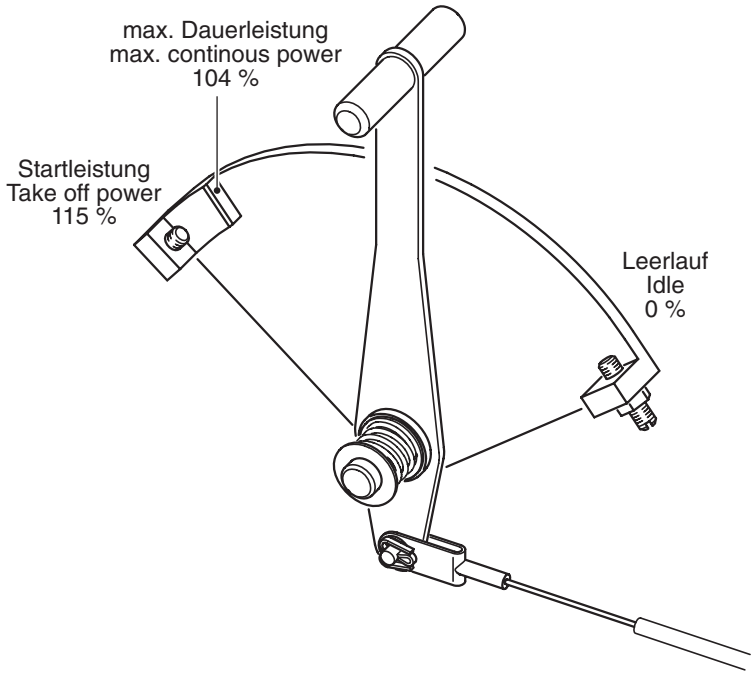


fig. 39

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■ CAUTION: Adjustable positive stops for idle- and full throttle position are of course required.

These stops have to be designed such to render adjustibility and to prevent overload of the idle stop on the carburetor.

d03193

15.5) Location and determination of the throttle position for max. continuous power

It is a necessity for trouble free engine operation that the pilot can locate the exact throttle position for max. continuous performance.

■ CAUTION: A manual determination (e.g. by a graduated disk) is not precise enough and therefore not permitted.

The exact determination is achieved electronically by a PC program especially developed for this engine.

For further details refer to Maintenance Manual 914, chapter "Control system of the turbo charger".

NOTES

16) Air intake system

See fig. 43.

The pressure side intake system from turbo charger to the carburetors is included in the volume of supply. Only the airduct to turbo charger and drainage line of airbox have to established.

16.1) Operating limits

Temperature in airbox:

max. intervention temperature ..... 72 °C (162 °F)

*max. intervention temperature ..... 88 °C (162 °F)

** 914 UL from S/N 4,420.200 (TCU p/no. 966741 version.4.6)*

** 914 F from S/N 4,417.598 (TCU p/no. 966741 version.4.5)*

Low air temperature in the airbox is favourable for engine performance and against knocking tendency at combustion. If need be install intercooler.

The certification to the latest requirements such as FAR and EASA has to be conducted by the aircraft builder.

CO-Measurement:

CO-Emission ..... min. 1,5 % CO at max. continuous output
CO-Emission ..... min. 3,0 % CO at full throttle and maximum speed

Measured on each single cylinder. Measuring point is analog to EGT-measurement. See chapter "Exhaust system".

■ CAUTION: Any changes on the air intake system (e.g. modification on the airbox, usage of an intercooler etc.) can affect the flow rate in the air intake system and the fuel mixture ratio. In the course of certification the fuel mixture process must be proofed by a CO-measurement.

03194

16.2) Requirements on the air intake system

▲ WARNING: Carb icing is a common reason for engine trouble. No implements are included in the supply volume for preheating of the intake air.

Because of the generated heat by turbo charging preheating of the intake air is possibly not necessary. But an alternate air door or flap that draws air from the engine compartment is recommended as the air filter could possibly close by formation of ice.

Door or flap must be in front of turbo charger (suction side)!

Preheating of the intake air will result in performance loss because of the lower air density.

▲ WARNING: All items of the air intake have to be secured against loss.

▲ WARNING: The certification to the latest requirements such as FAR and EASA has to be conducted by the aircraft manufacturer.

Air intake socket (1) on turbo charger

outside dia. ø ..... 60 mm (2 3/8")
slip-on length ..... max. 25 mm (1")

■ CAUTION: Utilize the full slip-on length on all connection. Secure hoses by suitable spring type clamp or screw clamp.

16.2.1) Requirements on the intake air ducting

- max. length of ducting 500 mm (20 in.)
- min. inside dia. at least outside dia. of the intake socket on turbo charger
- min. mean bending radius 100 mm (4")

◆ NOTE: Compression process in the turbo charger will heat up air considerably, depending on pressure ratio. Usual temperature rise of 40 °C (72 °F) at take-off performance.

High engine performance needs air temperature as low as possible at turbo air intake. Therefore the air filter should be located in a recess of the engine cowling or separated from warm air by partitioning such that via on opening ambient air can be aspirated.

■ CAUTION: Air temperature above the limit will automatically reduce boost pressure with consequent performance loss. The automatic back off on boost pressure will protect the engine against damage from overstressing.

03194

Notes regarding too high air temperatures in the air box:

If in case of high intake air temperature the max. air temperature in the airbox is frequently or permanently above the limit, the arrangement of air intake has to be improved or an intercooler has to be installed.

◆ NOTE: Intercooler is not in the supply volume.

Intercooler has to be installed between pressure side of turbo (2) and inlet (3) into airbox.

Requirements on the intercooler:

- a minimum flow rate of 300 m^3/h (390 yd^3/h) has to be warranted for all conditions
- the pressure loss must not exceed 15 hPa

■ CAUTION: No additional forces or moments are allowed on turbo charger or airbox, therefore the intercooler has be supported independent and free of vibrations.

■ CAUTION: Check the CO-emission when installing an intercooler and adjust the jeting if necessary.

▲ WARNING: The certification to the latest requirements such as FAR and EASA has to be conducted by the aircraft manufacturer.

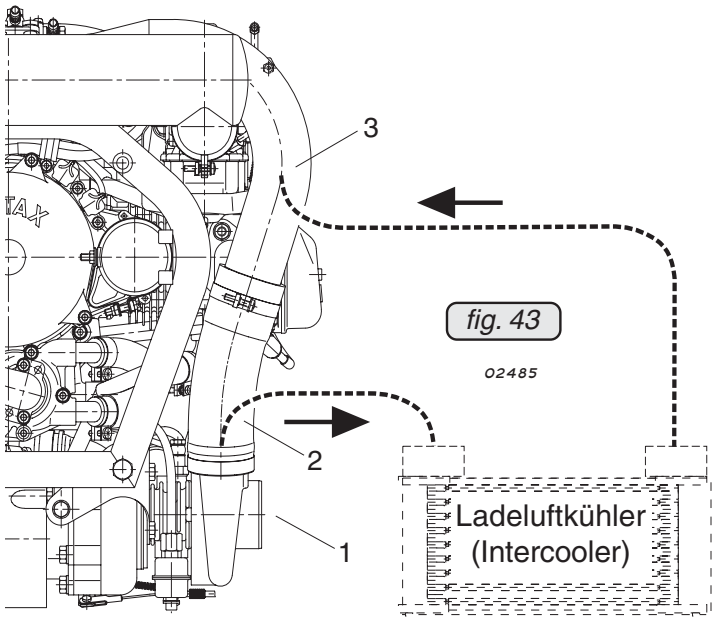


fig. 43

02485

03194

16.2.2) Airfilter

■ CAUTION: A minimum flow rate of 6,23 m^3/min. (220 cfm) has to be warranted for all conditions.

The pressure loss must not exceed 5 hPa.

▲ WARNING: Use only filter elements which will not tend to restrict the flow when in contact with water.

16.2.3) Airbox

See fig. 44.

The airbox is furnished with 2 drain holes at the lowest position possible.

The holes are necessary to drain fuel from flooding float chambers caused by badly closing float valve.

◆ NOTE: This drain bores are very small (1,5 mm (1/16") dia.). Compensation of process conditions is taken care of by the TCU.

Drainage lines:

▲ WARNING: Connect draining lines without fail, otherwise emerging fuel could drip onto the exhaust system. RISK OF FIRE!

- The lines have to be routed such that in case of damage the surplus fuel is drained away suitably.
- Route the lines without kinks and avoid narrow bends.
- Route the lines with a continuous decline.
- The lines have to be protected against any kind of blockage e.g. by formation of ice.

■ CAUTION: With closed or blocked drainage bores fuel could flow into combustion chamber, possibly ruining the engine by hydraulic lock.

03194

Connecting nipple (1) of drainage line

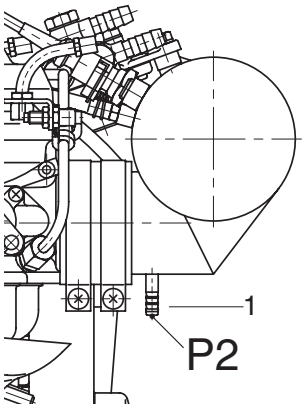
outside dia. ø ..... 6 mm (1/4")
slip-on length ..... max. 17 mm (11/16")

■ CAUTION: Utilize the complete slip-on length. Secure hoses by suitable screw clamps or by crimp connection.

Location of connecting nipple P2:

fig. 44

02486



04878

connecting nipple	axis x-axis mm	y-axis mm	z-axis mm
cylinder side 1/3	-568	-180	-20
cylinder side 2/4	-590	180	-20

16.3) Notes to employment of the air filter

BRP-Rotax offers an air filter as described below.

▲ WARNING: The certification to the latest requirement such as FAR and EASA has to be conducted by the aircraft manufacturer.

The following points should assist the aircraft manufacturer at the choice of a suitable filter.

Air filter:

- four fold cotton fabric
- face covered with metal screen
- a min. flow rate of 6,23 m³/min. (220 cfm)

03194

NOTES

03194

17) Pressure sensors

See fig. 45/46.

2 pressure sensors are included in the supply volume of the engine and connected by plugs with the wiring harness.

▲ WARNING: Since a failure of pressure interconnections (1) of airbox, float chambers, fuel control and pressure sensor would possibly result in an **engine stop** all these interconnections have to made very carefully.

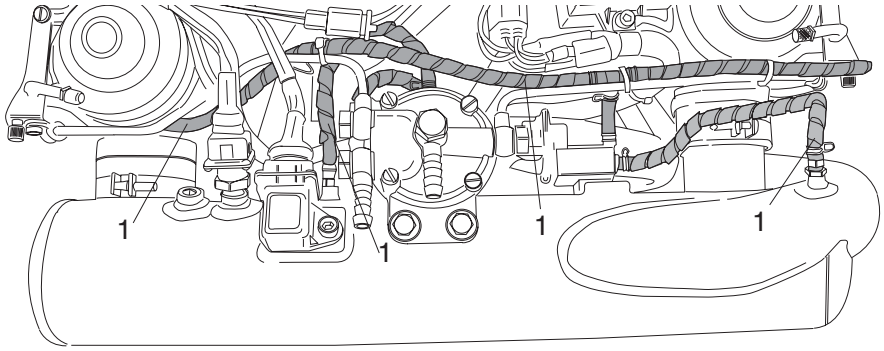


fig. 45

05740

◆ NOTE: To avoid any mix-up of pressure sensor wiring, plug connections are colour coded.

grey plug connection ❷	➪	**static pressure sensor**
black plug connection ❸	➪	**airbox pressure sensor**

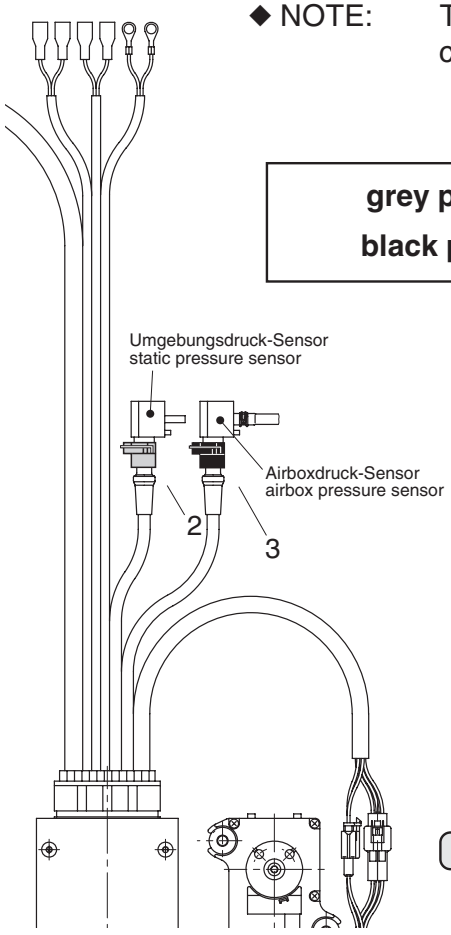


fig. 46

02488

03194

17.1) Static pressure sensor

See fig. 47.

- effective range: 100 ÷ 1200 hPa
  deviation: max. ± 40 hPa
- operating temperature: min. - 40 °C (-40 °F)
  max. +125 °C (257 °F)
- dimensions and attachment: see sketch (fig. 47)
- fitting position:

  The pressure connection (Pos. (3) fig. 47) points downwards to prevent possible condensate from entering the sensor, i.e. the longitudinal axis z4 has to be parallel to z-axis in system of coordinates.

  tolerated deviation of parallelism: ± 60°
- location of installation:

  vibration neutralized installation in a stable zone, e.g. in cockpit.

  In the area of the pressure pick-up approx. the same atmospheric pressure (static air pressure) has to prevail as at inlet of turbo charger.

■ CAUTION: Remove protective cap before operating the sensor.

■ CAUTION: The pressure connection has to be protected against entering of foreign matter e.g. oil, fuel, water etc.

◆ NOTE: Location of installation is limited by the length of the wiring harness.

- length of cable assy.: approx. 250 mm (10 in.) from TCU.

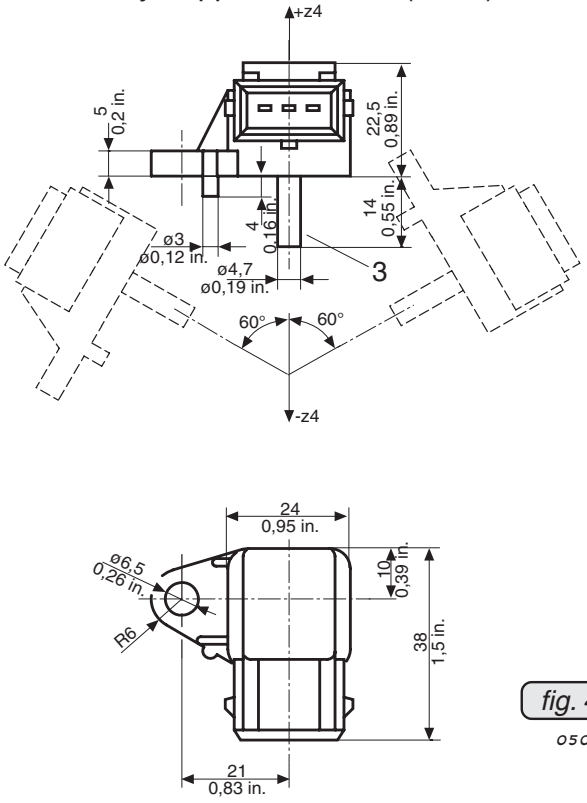


fig. 47

05091

03194

18) Servo motor / Servo cable

See fig. 50/51.

The correct adjustment of the servo cable (1) and consequently the waste gate (2) was made already on the course of the testrun at BRP-Rotax.

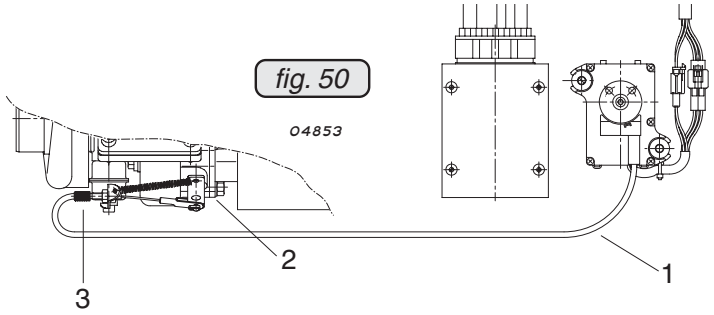


fig. 50

18.1) Servo motor

Prior to engine operation check the position of the waste gate as follows:

▲ WARNING: Engine stop - ignition "OFF".

- Check of the waste gate accordance with the Maintenance Manual 914 F.

Additionally, only the actual attaching of the servo motor has to be performed.

- operating temperature:
  min. - 20 °C (- 4 °F)
  max. +60 °C (140 °F)
- dimensions and attachment:
  see sketch (fig. 51)
- location of installation:
  vibration neutralized place

▲ **WARNING: Installation in the engine compartment is not permitted since the servo motor is not of a fire resistant construction.**

A recommendable location is in the cockpit below the instrument panel.

◆ NOTE: Place of installation is limited by the length of the servo cable.

- location of installation:
  approx. 1000 mm (40") from waste gate

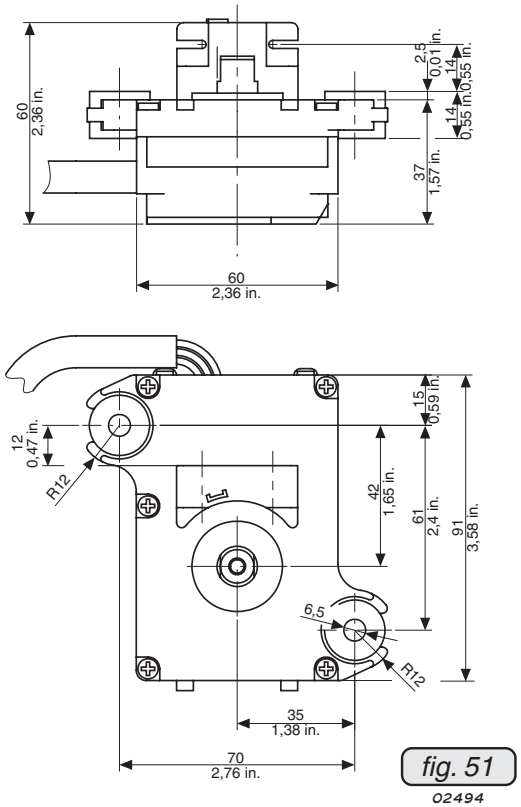


fig. 51

03194

18.2) Servo cable

- bending radius: min. 50 mm (2")

Following temperatures must be measured on the positions set out in figure 51a and must **not** be exceeded during take-off and after engine stop (heat accumulation).

Pos.	Description	Temperature
(1)	cable conduit	max. 120 °C (250 °F)
(2)	cable support	max. 120 °C (250 °F)
(3)	wire rope	max. 140 °C (280 °F)

■ CAUTION: All temperature limits must be verified at the first time of installation of the ROTAX 914 into an airframe, or at any modification of the airframe as it may influence such temperatures.

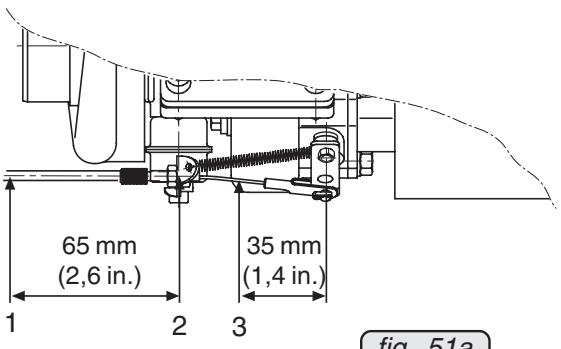


fig. 51a

02617

03194

19) Electric system

See fig. 52.

The engine is supplied with the wiring completed and ready to operate. Only the following connections to the aircraft have to be established.

◆ NOTE: Throughout this documentation as name for the "electrical load pressure control" TCU stands for **T**urbo **C**ontrol **U**nit.

- integrated generator
- external rectifier-regulator
- electronic modules
- electric starter
- start relay
- 2 electric fuel pumps
- TCU
- isolating switch for servo motor
- 2 lamps (boost- and warning lamp)
- items conditional for operation like circuit breakers, ON-OFF switches, control lamps, relays, instrumentation and capacitors

Optional extras

- external alternator (as option if the output of the integrated generator is inadequate)
- electric rev-counter (accessory)

03195

19.1) Requirements on circuit wiring

■ CAUTION: The connections have to be completed by the aircraft manufacturer in accordance to effective certification and wiring diagram (fig. 52).

The electromagnetic compatibility (EMC) and electromagnetic interference (EMI) is greatly affected by the wiring and has to be checked for each installation. Refer to chapter 19.1.1.

▲ WARNING: The supply to the various consumers (e.g. battery) has to be protected adequately by fuses (consult wiring diagram). Using fuses too large may result in damage to electric equipment.

Under no circumstances route consumers cables (e.g. battery) side by side with ignition cable. Induction could cause problems.

■ CAUTION: An excess-voltage protection has to be realized by the aircraft manufacturer in accordance to effective regulations.

▲ WARNING: The certification to the latest requirements such as FAR or EASA has to be conducted by the aircraft manufacturer.

▲ WARNING: Do not bend, kink, pinch or otherwise improperly stress the wiring harness. Use proper routing, clamping and strain relief on wiring harnesses.

19.1.1) Electromagnetic compatibility (EMC)

The engine complies with the requirements of EMI and lighting protection as per standard RT CA DO-160C, sections 18, 20-22 and IEC 801-2.

The following EMC/EMI tests were performed:

- Radio frequency Susceptibility (conducted)
- Radio frequency Susceptibility (radiated)
- Audio Frequency Susceptibility
- Lightning Susceptibility
- Conducted RF Interference
- Radiated RF Interference

O3195

19.2) Wiring diagram

See fig. 52.

Legend to wiring diagram (fig. 52)

Items 1-20, 52-54 are included in the standard volume of supply of the engine

Items 21-25 are available as accessory

Items 30-51 can't be supplied by BRP-Rotax

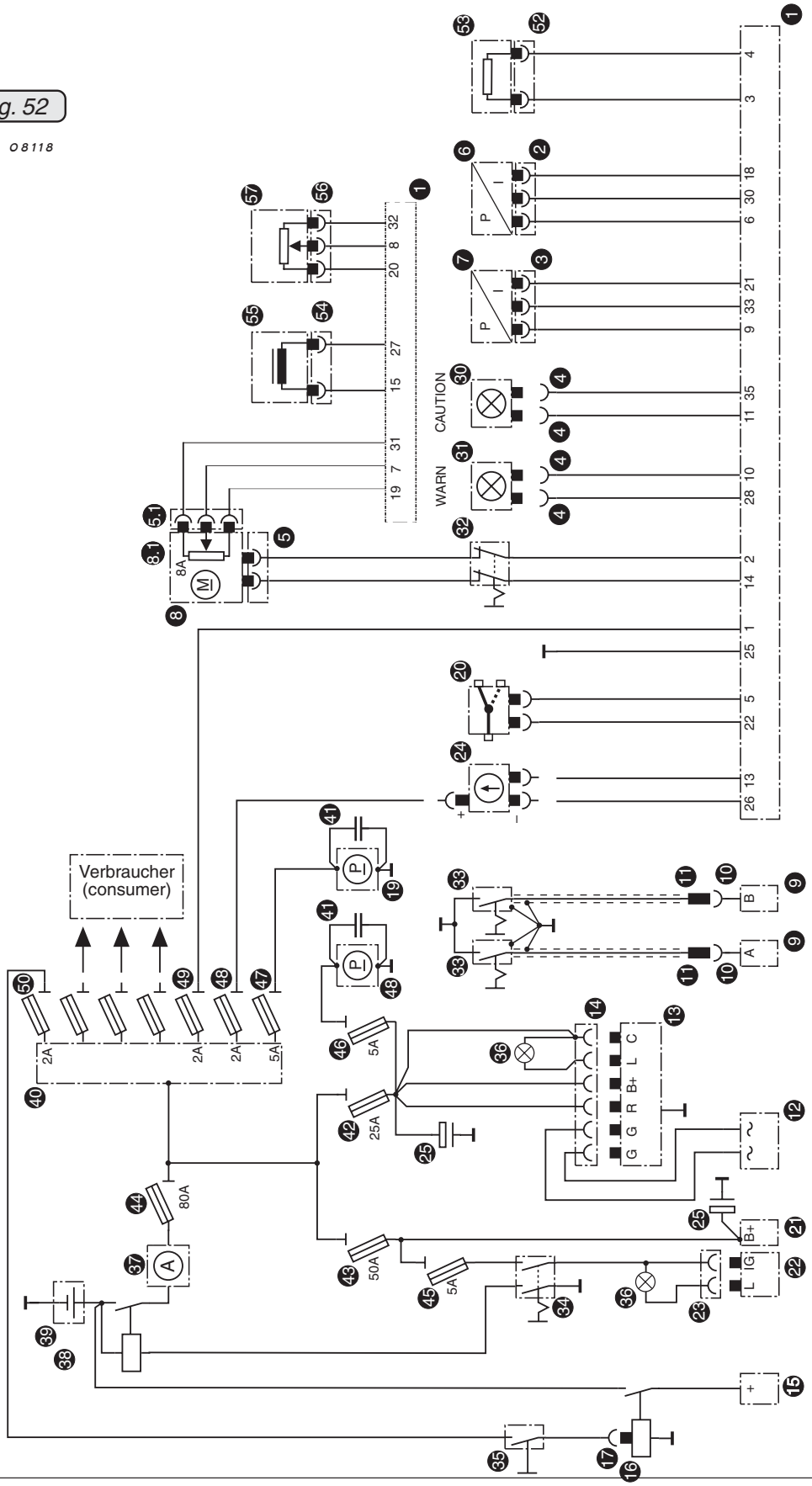
▲ WARNING: The certification of items/components which are not included in the standard volume of supply of engine has to be conducted by the aircraft builder to the latest requirements such as FAR or EASA.

1	36 pole plug receptacle
2-3	plug connection for pressure sensor
4	plug connection for lamps
5	plug connections for servo motor + **5.1** for potentiometer
6	pressure sensor (static pressure, atmospheric pressure)
7	pressure sensor (airbox - already wired in advance)
8	servo motor + **8.1** potentiometer
9	2 electronic modules (A and B)
10-11	plug connection for ignition switch
12	integrated generator
13-14	external regulator - rectifier with plug connections
15	electric starter
16-17	starter relay with plug connection
18-19	electric fuel pumps
20	3-way solenoid valve (float valve pressure - already wired in advance)
21-23	external alternator with connections
24	electric rev-counter
25	capacitor
30-31	lamps
32	isolating switch for servo motor
33	2 ignition switches
34	master switch
35	starter switch
36	control lamp
37	amperemeter
38	battery relay
39	battery
40	bus bar
41	capacitor
42-51	circuit breaker
52	plug connection for airbox temprature sensor
53	airbox temperature sensor (already wired in advance)
54	plug connection for trigger coil assy.
55	trigger coil assy. (speed)
56	plug connection for throttle positioning sensor
57	throttle positioning sensor (already wired in advance)

03195

fig. 52

O 8118



Wiring symbols to DIN 40712, 40713, 40716 and 40719.

O 3195

19.3) Description of the Turbo Control Unit (TCU)

See latest Operators Manual 914 Series, chapter 9.5.

19.4) Technical data and connection of the electric components

19.4.1) Integrated generator

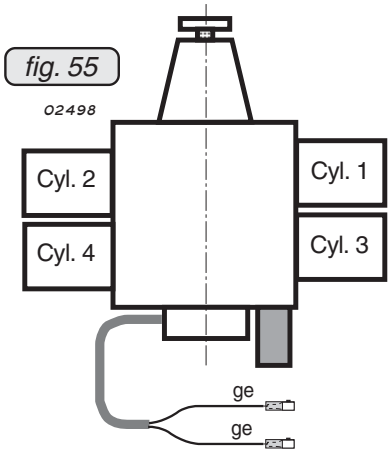


fig. 55 02498

See fig. 55

Feeding wires (1) from the generator to rectifier-regulator on left side of ignition housing (see fig. 55).

- 2 flexible cables, 1,5 mm² yellow (in shielding metal braid)
- length approx. 660 mm (26 in.) starting from ignition housing
- with on each plug socket 6,3 x 0,8 to DIN 46247

◆ NOTE: approx. 250W AC output at 5800 (r.p.m.)

For DC output in connection with rectifier-regulator see chapter 19.4.2.

19.4.2) Rectifier-regulator

See fig. 56/57.

- type: electronic full-wave rectifier regulator
- effective voltage: 14 ± 0,3 V (from 1000 ± 250 r.p.m.)
- current limit: max. 22 A
- max. permissible component temperature: +80 °C (176 °F) (measured in area (1))
- weight: 0,3 kg (.66 lb)

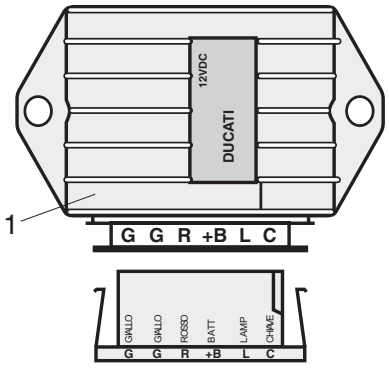


fig. 56 02499

Description of connections:

G = yellow - from generator
R = red - to battery, positive terminal
+B = battery positive terminal
L = warning lamp circuit
C = control or field circuit

03195

Requirements for flawless operation of the rectifier-regulator

- the rectifier-regulator has to be protected by a slow blowing 25A fuse.
- wire size of the main circuit of at least 2,5 mm^2 (14 AWG)
- a capacitor (fig. 52 Pos. (25)) of at least 22 000 µF / 25 V is necessary.

■ CAUTION: The voltage difference between battery and terminal **C** of regulator should be less than 0,2 V.

Use cables in this area as short as possible and with adequate cross section.

■ CAUTION: Never sever connection between terminal **C** and **+B** of regulator e.g. by removal of a fuse.

During engine stop break circuit between battery and terminal C to avoid discharge of battery!

◆ NOTE: A charge-indicating lamp 3W/12V (fig. 52, pos. (36) may be fitted on the instrument panel.

Current:

■ CAUTION: The graph current over engine speed has been determined and is valid only at the following conditions.

ambient temperature: ..... 20 °C (68 °F)

voltage: ..... permanent 13,5 V

tolerance: ..... max ± 5%

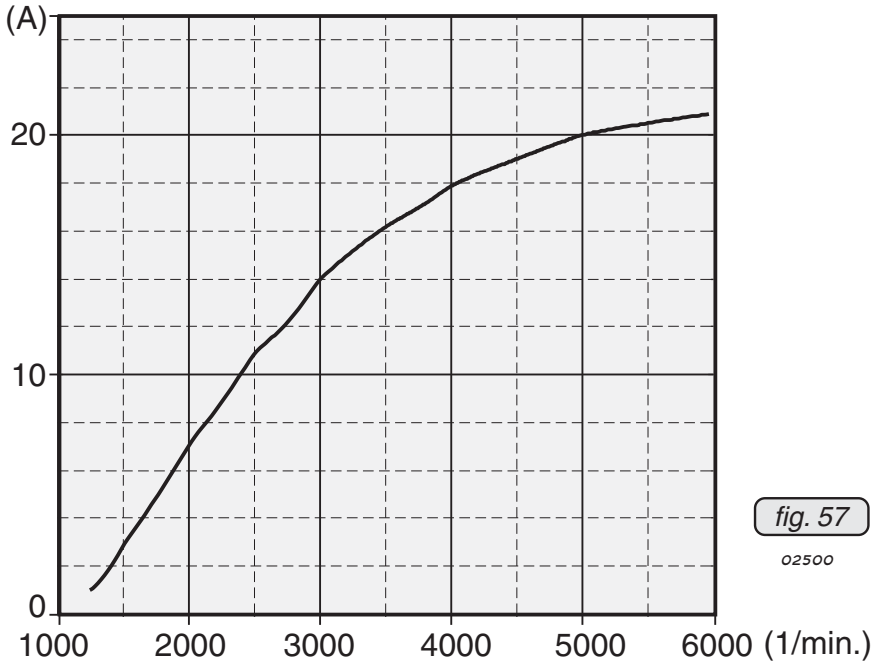


fig. 57

02500

03195

19.4.3) Electronic modules

See fig. 4/58.

Ambient temp. for the electronic modules (1): max. 80 °C (176 °F).

19.4.4) Ignition switches (on-off switch)

See fig. 58 and 58/1.

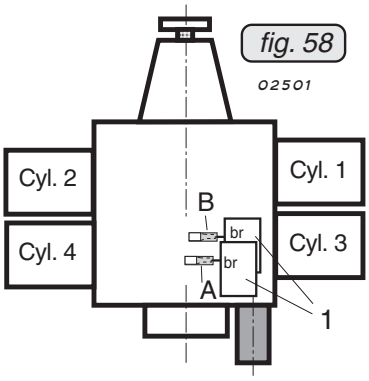


fig. 58

02501

- type: two separate, suitable on-off switches (fig. 52, pos. (33))
- switching voltage: min. 250 V
- switching current: min. 0,5 A

Wires to on-off switches on the electronic module (see fig. 58).

- one each flexible wire 0,75 mm² (18 AMG), brown

  length approx. 35 mm (1 3/8") beginning at electronic module with one each plug socket and insulating sleeve 3,96 mm. At the new version the cable grommet and faston connector are integrated in the 6-pole connector housing. See also SI-914-016, latest issue.

◆ NOTE: One each cable grommet and flat pin terminal are supplied loosely packed.

Faston connector and insulation sheath of the old version are available as spare part. See also SI-914-016, latest issue.

- Wire of top electronic module (marked "A") for ignition circuit A.

  Wire of bottom electronic module (marked "B") for ignition circuit B.

◆ NOTE: Ignition circuit A controls: top spark plugs of cylinders

Ignition circuit B controls: lower spark plugs of cylinders

■ CAUTION: The electromagnetic compatibility (EMC) and electromagnetic interference (EMI) depends essentially on the wire used. See fig. 58/1.

Min. section area: 2x 0,75 mm² (18 AMG) (shielded flexible cable, shielding braid on both ends grounded to prevent EMI).

Not or insufficient shielded cables can cause engine shut-off due to electromagnetic and radio interference.

The metal base of each ignition switch must be grounded to aircraft frame to prevent EMI.

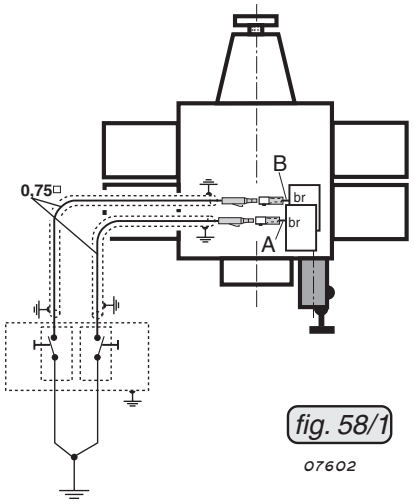


fig. 58/1

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19.4.5) Electric starter

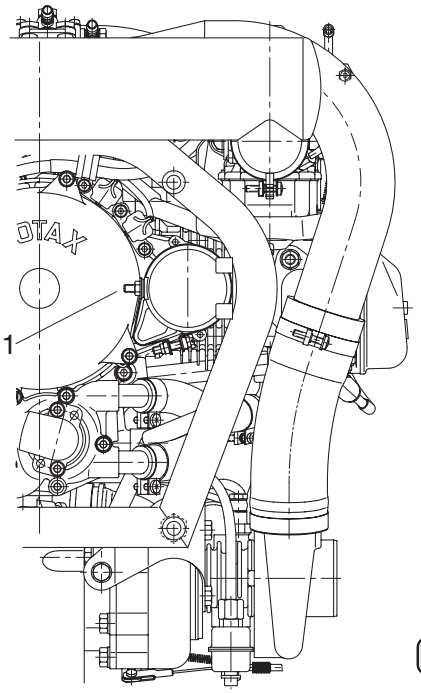
See fig. 59.

Wire from starter relay to the electric starter

- cross section of at least 16 mm^2 (6 AWG)
- output: 0,7 kW / 0,9 kW optional
- positive terminal (1): M6 screw (tightening torque 4 Nm (35 in.lb)) suitable for ring terminal to DIN 46225 (MIL-T-7928)
- grounding: via engine block

■ CAUTION: Suitable for short starting periods only.

■ CAUTION: Max. 80° (176 °F) temperature range by the electric starter housing. Activate starter for max. 10 sec. (without interruption), followed by a cooling period of 2 min!



02502

fig. 59

03195

19.4.6) Starter relay

See fig. 60.

- nominal voltage: 12 V
- control voltage: min. 6 V
  max. 18 V
- switching current: max. 75 A (permanent)
  max. 300 A (for 1 sec.)
- ambient temperature range:
  min. – 40 °C (-40 °F)
  max. +100 °C (214 °F)
- weight: 0,145 kg (.32 lb)
- current connections (1): M6 screw (tightening torque 4 Nm (35 in.lb)) suitable for ring terminals to DIN 46247 (MIL-T-7928)
- control wiring (2): plug connector 6,3x0,8 suitable for spade connector to DIN 46247 (MIL-T-7928)
- grounding: via housing

■ CAUTION: Activation of start relay limited to short duration. Over a period of 4 min. operation, the duty cycle is 25%.

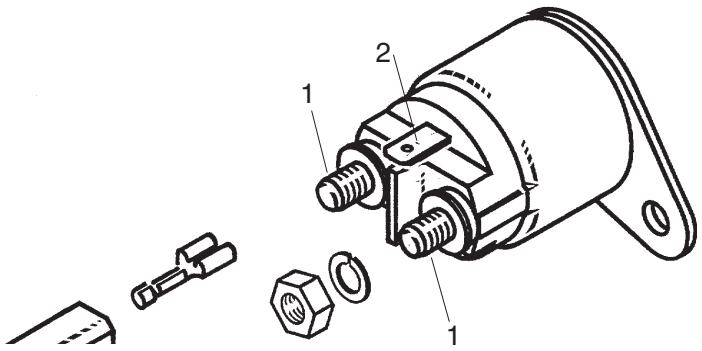


fig. 60

02503

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19.4.7) Electric fuel pumps

See fig. 61/62.

- installation: see fuel system, chapter 14
- voltage: 12 V/DC
- connections: + terminal: M 4 screw connection

  – terminal: M 5 screw connection

  suitable for ring terminals to DIN 46225

For radio interference suppression a capacitor (fig. 52 Pos. (41)) of 1µF / 100 V has to fitted as near as possible to the terminals.

▲ WARNING: The certification to the latest requirements such as FAR or EASA has to be conducted by the aircraft manufacturer.

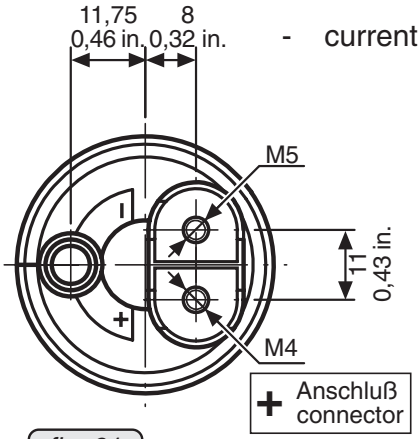


fig. 61

05120

- current input:

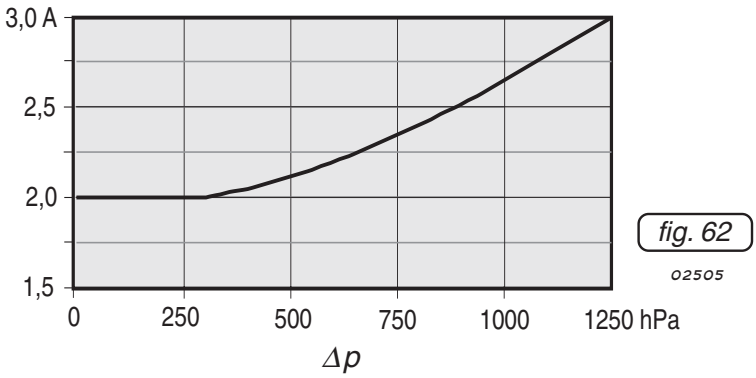


fig. 62

02505

The current input per fuel pumps

by one fuel pump ~ 1,7 A

by two fuel pumps (Series) ~ 1,5 A

The diagram shows the current input over pressure.

Take note of the following:

- The diagram outlines minimum capacity at nominal voltage on pump.
- Pressure- and suction head are "ZERO".
- Graph is effective on a seasoned pump only, running-in period approx. 30 min.
- Fuse:

  Each of the two fuel pumps has to be protected by y slow blowing 5A fuse in accordance with wiring diagram (fig. 52).

▲ WARNING: All connections have to be established by the aircraft manufacturer in compliance with regulations such as FAR or EASA and the effective wiring diagram (fig. 52).

▲ WARNING: An essential point is according to regulations, that the fuel pumps are connected on two completely independent power supplies.

03195

19.4.8) Turbo Control Unit (TCU)

See fig. 63.

- voltage: 12 V/DC min. 6 V
  max. 18 V
- current input: see chapter 19.5.

◆ NOTE: At wrong polarity of the supply voltage both lamps will light up.

- operating temperature range: min. - 25 °C (-13 °F)
  max. +70 °C (+160 °F)
- storage temperature range: min. - 40 °C (-40 °F)
  max. +70 °C (+160 °F)
- weight: approx. 425 g (1 lb)
- dimensions and attachment: see sketch (fig. 63)
- place of installation:

▲ WARNING: **Installation in the engine compartment is not permitted since the TCU is not of a fire resistant construction.**

A recommendable location is in the cockpit, below the instrument panel.

The TCU has to be in an area were it is protected against moisture.

◆ NOTE: Place of installation is limited by the length of the wiring harness.

Support of the TCU on the 4 rubber shock mounts which ensures an attachment free of vibrations.

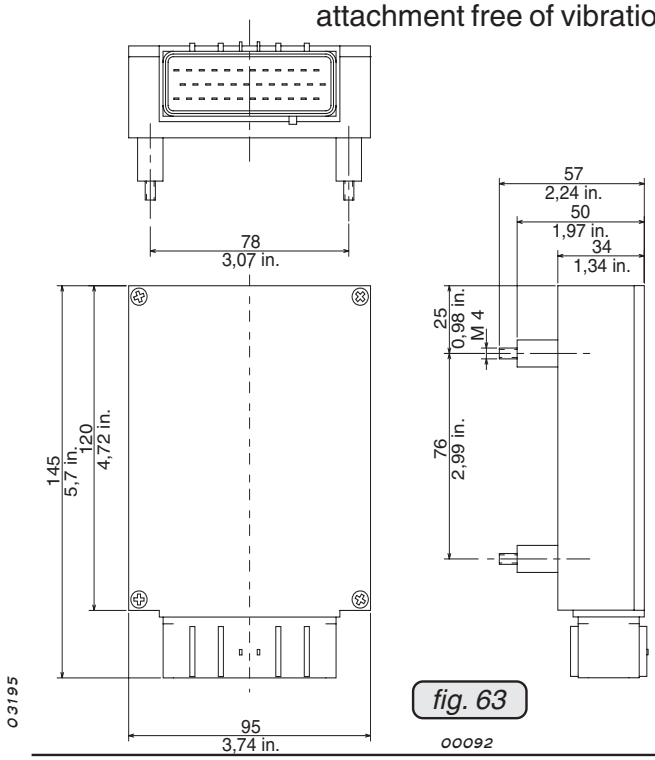


fig. 63

▲ WARNING: If the standard attachment should not be utilized or changed, certification to the latest requirements such as FAR or EASA has to be conducted by the aircraft manufacturer.

▲ WARNING: Choose place of installation such, that operation is within the specified temperature limits.

▲ WARNING: The TCU comprises electronic components and is therefore completely sealed. **The TCU is allowed to be opened only by persons authorized by BRP-Rotax!**

- connections: **+** terminal: flexible cable 0,75 mm^2 (18 AWG) white No. 1*
  – terminal: flexible cable 0,75 mm^2 (18 AWG) white No. 25*

* from the 36 pole plug receptacle of the TCU with ring terminal 4,2 mm dia. to DIN 46225

- fuse:

  The TCU has to be protected by a slow blowing 2A fuse in accordance with the wiring diagram, fig. 52.

19.4.9) Isolating switch for servo motor

See fig. 52.

The isolating switch serves to break the circuit of the servo motor for a short time in case of surging of the TCU.

After a short hunting stable operation should follow.

- design: 2 pole on-off switch (fig. 52 Pos. (32))

■ CAUTION: The isolating switch has to be designed such that it is guarded against being turned "off" by mistake or unintentionally. The fixed and secured position is **"ON"**.

- switching voltage: min. 100 V
- switching current: min. 2 A
- place of installation:

  On the instrument panel in the pilot's field of view, anytime and easy to reach.

Installation instruction:

The isolating switch has to be installed directly into the lines from 36 pole plug receptacle to servo motor.

■ CAUTION: The servo motor is connected to DC supply. The polarity (wire 2 and 14) of the cables must not be changed, otherwise the sense of rotation would be reversed and control would be rendered ineffective.

To avoid any mix-up of the polarity cut first one wire and connect on switch as per wiring diagram (fig. 52).

After first wire is connected sever **second** wire and connect also to switch.

O3195

19.4.10) Boost lamp

See fig. 52.

- colour of lamp: **red** or colour as per effective regulations.
- voltage: 12 V(DC)
  depending on input voltage of TCU.
- current: max. 0,5 A
- connections: **+** terminal: flexible wire 0,75 mm² (18 AWG) white No. 10*
  – terminal: flexible wire 0,75 mm² (18 AWG) white No. 28*

  * from the 36 pole plug receptacle of the TCU, plug 6,3 x 0,8 to DIN 46247
- length approx. 600 mm (24 in) from TCU

■ CAUTION: Do not connect the **–** (neg.) terminal to ground or the + (pos.) terminal to bus (12 volt), each wire must be connected directly to the lamp. Use a two wire lamp; do not use a lamp that grounds through the base as this will defeat the warning system.

19.4.11) Caution lamp

See fig. 52.

- Colour of lamp: **orange** or colour as per effective regulations.
- Voltage: 12 V(DC)
  depending on input voltage of the TCU
- current: max. 0,5 A
- connections: **+** terminal: flexible wire 0,75 mm² (18 AWG) white No. 35*
  – terminal: flexible wire 0,75 mm² (18 AWG) white No. 11*

  * from the 36 pole plug receptacle of the TCU, plug 6,3 x 0,8 to DIN 46247
- length approx. 600 mm (24 in) from TCU

■ CAUTION: Do not connect the **–** (neg.) terminal to ground or the + (pos.) terminal to bus (12 volt), each wire must be connected directly to the lamp. Use a two wire lamp; do not use a lamp that grounds through the base as this will defeat the warning system.

03195

19.4.12) External alternator (optional extra)

See fig. 64/65/66.

- output: max. 600 W DC at 6000 r.p.m.
- voltage: 14,2 V – 14,8 V
- ambient temperature range: min. - 30 °C (-22 °F)
  max. +90 °C (194 °F)

◆ NOTE: Voltage regulator is integrated in the alternator.

Feeding wiring to external alternator (1) located on the outside of propeller gear (see fig. 64).

- plus terminal (2): M6 screw suitable for ring terminal to DIN 46225 (tightening torque 4 Nm (35 in.lb))
- grounding: via engine block mount bracket
- control wiring (field circuit) (3) and warning lamp circuit (4): via supplied standard plug (Sumitomo 6111-2568), see fig. 66

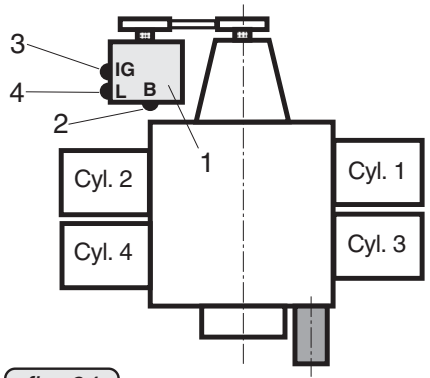


fig. 64

03199

03195

Requirements for correct operation of the integrated rectifier-regulator:

- the rectifier-regulator has to be protected by a slow blowing 50A fuse
- cross section of the main circuit at least 4 mm^2 (10 AWG)
- a capacitor (fig. 52 Pos. (25)) of at least 22 000 µF / 25 V is necessary
- current:

■ CAUTION: The current over speed graph has been determined and is effective only at the following conditions:

ambient temperature: 20 °C (68 °F)

voltage: permanent 13,5 V

tolerance: ± 5%

◆ NOTE: The speed of the auxiliary generator is 1,24 times crankshaft speed or 3 times the prop speed.

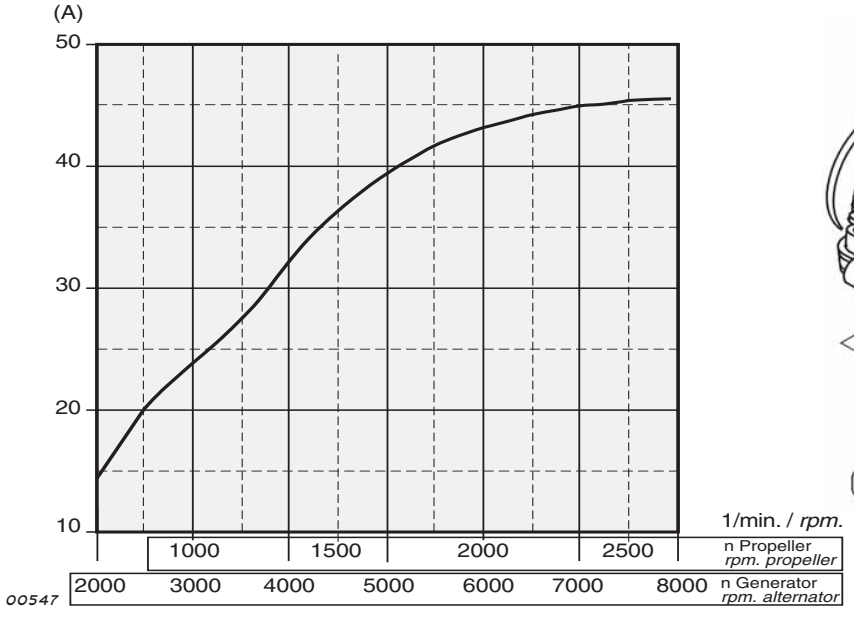


fig. 65

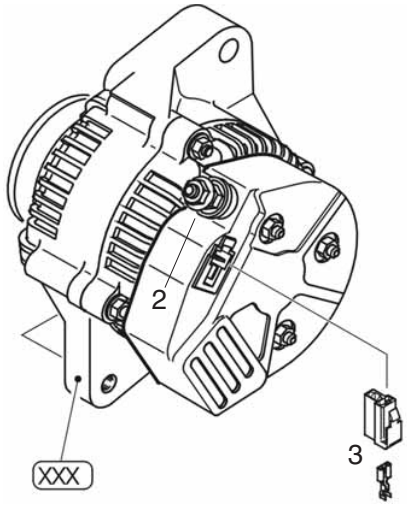


fig. 66

03195

19.4.13) Connection of the electric rev-counter (tachometer)

See fig. 52/67.

Feeding wiring to electric rev-counter from the 36 pole receptacle of TCU.

- connections: flexible wire 0,75 mm² (18 AWG) white No. 26*
  flexible wire 0,75 mm² (18 AWG) white No. 13*

  * from the 36 plug receptacle of TCU without plug connection
- length approx. 1000 mm (40 in) from TCU.

◆ NOTE: BRP-Rotax developed especially for this application a non-certified electric rev-counter. Certification to the latest requirements such as FAR or EASA has to be conducted by the aircraft manufacturer. See also SI-13-1996, latest issue.

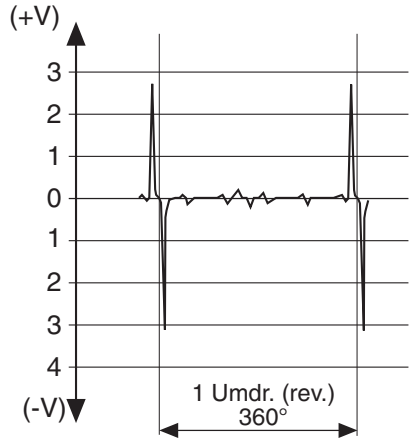
■ CAUTION: The graphs depicting output signals have been determined and are effective only at the following conditions.

Ambient temperature: 20 °C (68 °F)

Tolerance: ± 5%

The pick-up for the rev-counter generates one pulse per revolution. Pulse shape and pulse voltage as per recordings (oscillogram).

speed 500 rpm (load 100 Ω)



speed 500 rpm (load 100 kΩ)

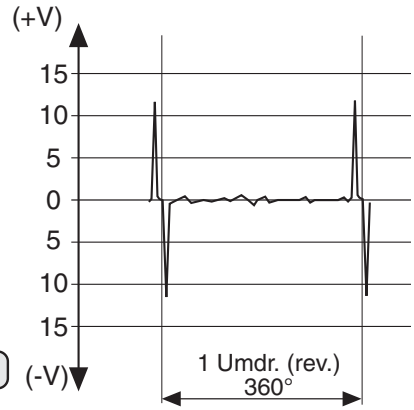
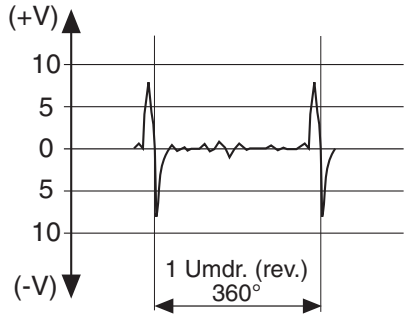


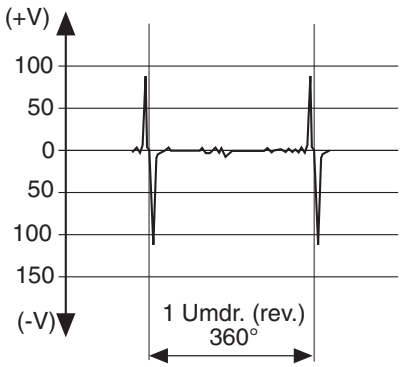
fig. 67

00219

speed 6000 rpm (load 100 Ω)



speed 6000 rpm (load 100 kΩ)



03195

19.4.14) Battery

See fig. 52.

■ CAUTION: To warrant reliable engine start use a battery of at least 16 Ah capacity.

19.5) Internal consumer of electric power

▲ WARNING: The power consumption of extra users has to be limited to the extent that the internal need of power, e.g. for fuel pumps is always covered.

Refer to graph, current output over speed of the integrated generator and the external alternator.

item	current consumption
fuel pump (main)	max. 3 A
fuel pump (stand by)	max. 3 A
TCU (1	max. 0,3 A
servo motor	max. 1 A
warning lamp (2	approx. 0,25 A
caution lamp (2	approx. 0,25 A
sum (3	**~ 8 A**

(1 internal power consumption, without servo motor and lamps

(2 standard value, actual value up to aircraft manufacturer

(3 without electric starter and start relay

03195

NOTES

20) Propeller drive

The propeller in tractor or pusher arrangement has to be fitted on the propeller flange in accordance to current certification. As required utilize one of the three possible pitch circle diameters (P.C.D.) on the flange.

Certification of the propeller sizing and arrangement to the latest requirement such as FAR or EASA has to be conducted by the aircraft manufacturer.

▲ WARNING: Never run the engine without a propeller installed as engine would suffer severe damage by overspeeding.

Never fit propeller directly on crankshaft.

20.1) Technical data:

See fig. 68.

- direction of rotation of the prop flange: counter clockwise, looking towards face of flange
- location: see system of coordinates
- attachment of propeller on prop shaft flange:
  - P.C.D 75 mm (2,95"): 6 bolt holes of 8 mm (.32 in.) dia
  - P.C.D 80 mm (3,15"): 6 bolt holes of 11,5 mm (.45 in.) dia
  - P.C.D 101,6 mm (4"): 6 bolt holes of 13 mm (.51 in.) dia.
- ratio of gear reduction: 2,4286 (51 T/21 T)
- max. torque: 340 Nm (250 ft.lb.) at propeller
- max. moment of inertia : 6000 kgcm^2 (14.238 lb.ft.^{2})
- max. permitted static out-of-balance on a prop: max. 0,5 gm (.043 lb.in.)
- max. extension of the propeller shaft: 120 mm (4.72 in.)

◆ NOTE: In the course of certification a vibration analysis of the whole system (engine, suspension, propeller etc.) should be done.

If there are no limits found in the technical literature, a max. of 0,1 IPS (inches per second) at 5000 1/min. can be assumed.

03196

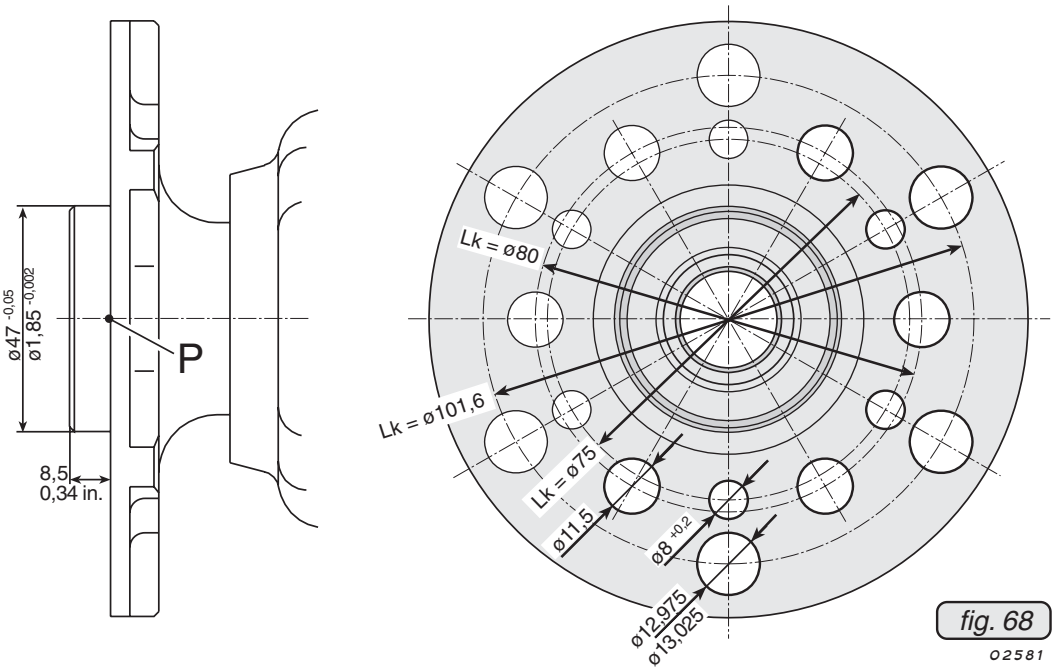


fig. 68

02581

03196

21) Vacuum pump

21.1) Technical data:

See fig. 69 and 69/1

Type: Airborne 211 CC, drive via propeller gear

- location of the necessary connection (1) and (2) on the vacuum pump

	Axis		
Connections	x axis mm	y axis mm	z axis mm
1	226	0	98
2	293	0	98

fig. 69

04866

- connections

  thread size: 5/8“ 16 T.P.I.
  tightening torque: hand tight and tighten up by max. 1,5 turn with ring spanner.

  Effective thread length: max. 17 mm (9/16")

- net weight: 0,8 kg (1 $^{3}/_{4}$ lb)
- power input: max. 300 W
- delivery rate: max. 0,165 dm^3 (10 in^3) per minute at 0,65 bar (10 p.s.i) as from 1900 rpm pump speed.

■ CAUTION: Pay attention to manufacturer's specifications

◆ NOTE: Speed reduction from crankshaft to vacuum pump is 1,842, i.e. the vacuum pump runs with 0,54 of engine speed.

▲ WARNING: Certification to the latest requirements such as FAR or EASA has to be conducted by the aircraft manufacturer.

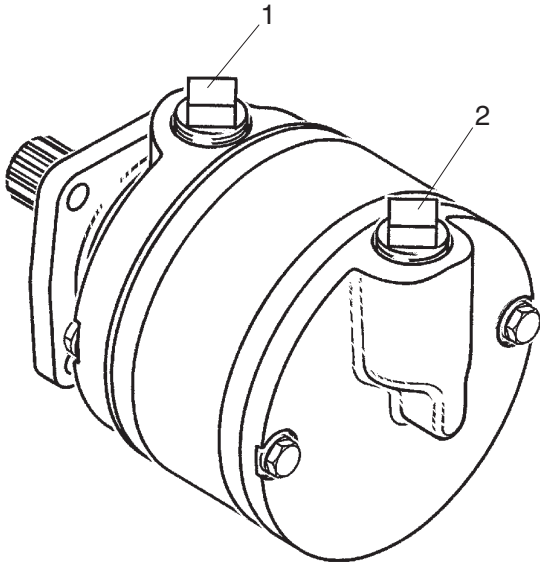


fig. 69/1

00255

03196

NOTES

22) Hydraulic governor for constant speed propeller

22.1) Technical data:

See fig. 70

Design: Woodward governor A210786 (for engine design 3 only), drive via prop gear

Location of centre of connection (P3):

	Axes		
Centre P3	x axis mm	y axis mm	z axis mm
	-373	-10	51

04867

- cable connection: see fig. 70
- cable travel: approx. 54 mm (2 1/8")

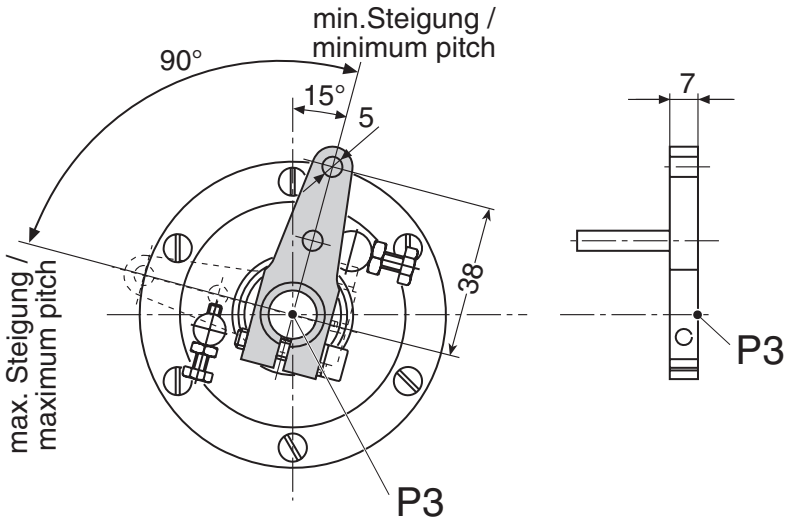


fig. 70

00556

- actuating force: approx. 3 N (during operation at max. speed) (.67 lb)
  limit load 6 N (1,35 lb)
- power input: max. 600 W
- operating pressure: max. 30 bar (435 p.s.i.)
- weight: 1,44 kg (3,2 lb)
  2,7 kg (6 lb) (inclusive drive unit)

◆ NOTE: Reduction ratio of crankshaft to governor is 1,842 e.g. the governor speed is 0,54 of the engine speed.

03196

NOTES

23) Connections for instrumentation

These connections to be established in accordance to certification and/or national specifications.

The certification for connections and connection lines have to be conducted by the aircraft builder to the latest requirements like FAR and EASA.

For notes regarding the electric rev-counter consult the chapter 19.4.13.

23.1) Sensor for cylinder head temperature:

See fig. 71/72.

◆ NOTE: A direct reading of the coolant temperature is not provided for.

The temperature sensor (1) is directly fitted into cylinder head i.e. a direct temperature reading of the cylinder head material is taken. This allows the exact measuring of the cylinder head temperature even in the case of coolant loss.

◆ NOTE: Readings are taken on the hottest cylinder, depending on engine installation.

- location: in the cylinder head of the cylinders 2 and 3, see fig. 4.
- connection: spade terminal 6,3x0,8 to DIN 46247
- grounding: via engine block
- graph of sensor resistance over temperature

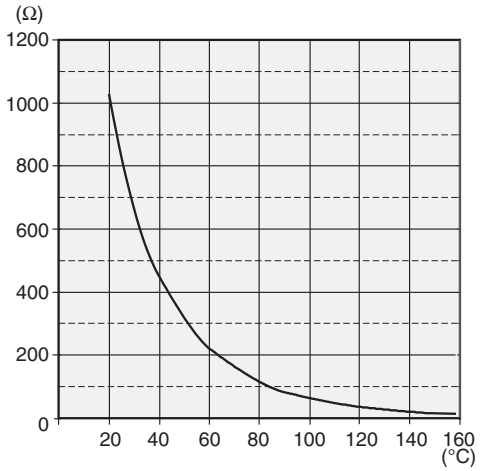


fig. 72

00227

04868

	Axes		
cylinder head	x axis mm	y axis mm	z axis mm
2	-200,0	241,0	-157,0
3	-387,0	-241,0	-157,0

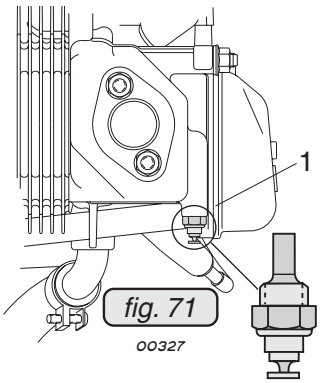


fig. 71

00327

■ CAUTION: The graph resistance over temperature has been determined, and is effective at the following conditions only.

ambient temperature: 20 °C (68 °F)
tolerance: ± 10%

03196

23.2) Sensor for oil temperature:

See fig. 73/74

- location: oil pump housing
- marking (2): marked with "TO" on oil pump flange

■ CAUTION: To avoid any mix-up with indication wiring, mark this particular cable also with "TO".

- position of the temperature sensor (1) on the oil pump flange:

	Axes		
point of support	x axis mm	y axis mm	z axis mm
	-115	46	-150

04869

- connection of sensor wiring: spade terminal 6,3 x 0,8 to DIN 46247
- grounding: via engine block
- graph of sensor resistance over temperature

■ CAUTION: The graph resistance over temperature has been determined, and is effective at the following conditions only.

ambient temperature: 20 °C (68 °F)

tolerance: ± 10%

BRP-Rotax offers a non-certified temperature indicating instrument. Refer to Illustrated Parts Catalog, latest issue.

▲ WARNING: Certification to the latest requirements such as FAR of EASA has to be conducted by the aircraft manufacturer.

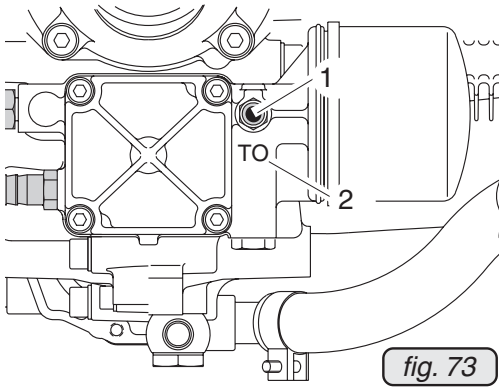


fig. 73

00226

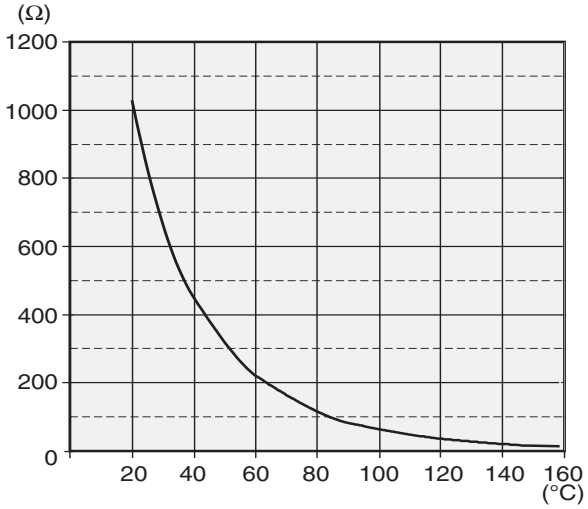


fig. 74

00227

03196

23.3) Oil pressure sensor

See fig. 75/76.

- location: oil pump housing
- position of connection on oil pressure pick-up (1):

point of connectio	Axes		
	x axis mm	y axis mm	z axis mm
--	ca. -100	75	ca. -150

04870

- connection of pick-up wiring: single pole screw connection for ring terminal 3 to DIN 46225 (tightening torque, max. 1Nm (8,848 in lb)
- grounding: via engine block
- graph of resistance over pressure

■ CAUTION: The graph resistance over pressure has been determined, and is effective at the following conditions only.

ambient temperature: 20 °C (68 °F)
voltage: 12 V
tolerance: ± 5%

BRP-Rotax offers a non-certified pressure gauge. Refer to Illustrated Parts Catalog, latest issue.

▲ WARNING: Certification to the latest requirements such as FAR of EASA has to be conducted by the aircraft manufacturer.

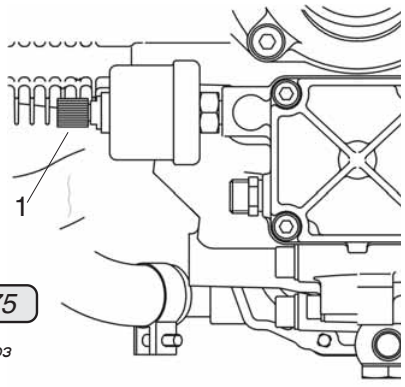


fig. 75

04903

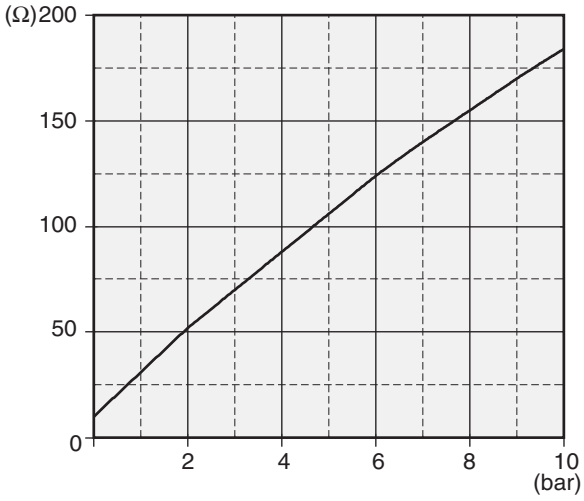


fig. 76

00229

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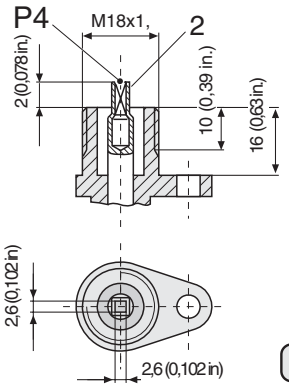
23.4) Mechanical rev-counter (tach drive):

See fig. 77/78.

- location: ignition housing (1)
- direction of rotation of the rev-counter shaft (2): clockwise, see fig.
- position of rev-counter drive:

04871

	Axes		
point of engagement P4	x axis mm	y axis mm	z axis mm
	-465	87	-160



05483

fig. 78

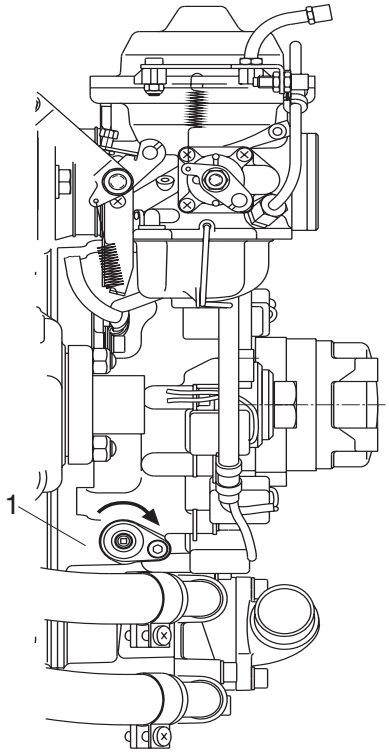


fig. 77

00562

- installation dimensions: see fig.
- reduction ratio: i = 4 i.e. 1/4 of engine speed

◆ NOTE: A flexible shaft for the mechanical rev-counter is readily available from BRP-Rotax.

03196

23.5) Monitoring of the intake manifold pressure

See fig. 79.

Connection nipple (1) to measure manifold pressure:

outside dia. ø ..... 6 mm (1/4")
slip-on length . max. 17 mm (11/16")

■ CAUTION: Utilize the total slip-on length on all joints. Secure hose by suitable screw clamps or crimp connection.

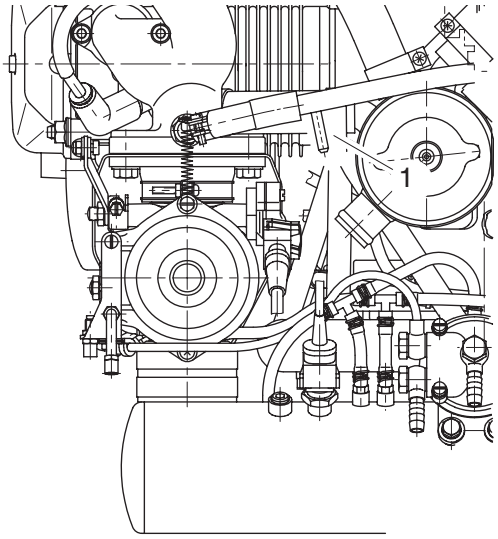


fig. 79

03200

▲ WARNING:

Protective covering to be utilized for transport and at engine installation only. If connection for pressure reading is not employed it has to plugged suitably.

■ CAUTION: Flawless operation of the indicating instrument needs the installations of a water trap between engine and instrument for the fuel condensate.

23.6) Air temperature in the airbox (optional)

See fig. 80.

To take air temperature readings in the airbox a connection is provided. This connection is closed on the standard engine by a plug screw.

- connection: tapping 1/8-27 NPT
  thread length approx. 9 mm (3/8")

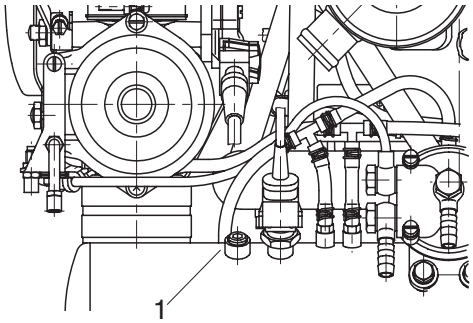


fig. 80

03200

03196

NOTES

24) Preparations for trial run of engine

▲ WARNING: Prior to engine start and operation review all instructions stated in the Operator's Manual.

Verification of the throttle lever detent for max. continuous power:

Performance check in accordance with Operator's Manual.

If nominal performance won't be reached or is in excess of, examination of the installation and engine will be necessary. Consult Maintenance Manual 914.

■ CAUTION: Don't conduct any test flights before fault has been traced and found.

03196

NOTES

25) BRP-Rotax Authorized Distributors for Aircraft Engines

See latest Operators Manual chapter 14 or in the Internet at the official Homepage **www.rotax-aircraft-engines.com**.

03196

NOTES

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Flugzeugtype / Type of aircraft

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